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COMPUTER ABSTRACTS

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CONTENTS

GENERAL 1
DESIGN 2
LEARNING AND PATTERN RECOGNITION .. 3
MATHEMATICS 4
TECHNIQUES 6
ACCESSORIES 8
ELEMENTS 9
ANALOGUE 12
DIGITAL 12
PROGRAMMING 12
APPLICATIONS
Aero- and Astronautical 13
Business 13
Chemical 14
Control—General Systems 14
Electronics 14
Engineering, Electrical 15
Engineering, Mechanical 16
Engineering, Structural 16
Information Retrieval 16
Mechanical Translation 16
Medical 17
Military 17
Nuclear 17
Physics 17
Simulation 18
Transport 18
Miscellaneous 18
BOOKS 19
AUTHOR INDEX 19
PATENT INDEX 20

GENERAL

2104 **Conference Proceedings.** *Computer J.*, **4,** July 1961, 87. Brief introduction to the Proceedings of the Conference on Data Transmission, Document Handling and Character Recognition held by the British Computer Society, 27-29 March 1961. The Proceedings occupy pages 88-167 of the July 1961 issue of *Computer Journal*. The papers are individually abstracted in this issue of *Computer Abstracts* under Refs. 2110, 2139, 2140, 2143, 2147, 2199, 2200, 2204, 2207, 2295, 2298 and 2357.

2105 **Enquête sur la technologie des calculatrices numériques en Europe.** (Enquiry into digital computer technology in Europe.) N. M. Blachman, *Bull. Provisional Int. Computation Centre*, No. 14, July 1961, 18-38. (In French) Translation of a report "The state of digital computer technology in Europe," *Commun. ACM*, **4,** June 1961, 256-265 (*C.A.*, **5,** Sept. 1961, Ref. 1810).

2106 **Glossaries for computing and data processing.** M. Grems, *Commun. ACM*, **4,** July 1961, 323-324. Brief survey of organisations working towards a comprehensive glossary of computing and data processing terms.

2107 **Irreversibility and heat generation in the computing process.** R. Landauer, *IBM J. Res. & Dev.*, **5,** July 1961, 183-191. In this paper it is argued that computers inevitably involve devices which perform logical functions that do not have a single-valued inverse. This logical irreversibility is associated with physical irreversibility and requires a minimal heat generaton, per machine cycle, typically of the order of kT for each irreversible function. This dissipation serves the purpose of standardising signals and making them independent of their exact logical history. Two simple, but representative, models of bistable devices are subjected to a more detailed analysis of switching kinetics to yield the relationship between speed and energy dissipation, and to estimate the effects of errors induced by thermal fluctuations. 8 refs.

2108 **Organization of a computing service for industry and commerce.** A. R. Bagshaw, *Computer J.*, **4,** July 1961, 181-183. This paper, given at the British Computer Society Conference, July 1960, reviews the first five years of operation of the Ferranti Computer Centre and considers some of the problems to be met in the near future.

2109 **The periodical literature of computer technology.** J. E. Holmstrom, *Bull. Provisional Int. Computation Centre*, No. 14, July 1961, 7-17. A survey of periodicals in the computer field. Various journals which deal wholly or partly with computers are listed. Details are also given of bibliographical, abstract and review publications. 3 refs.

2110 **The place of character recognition, data transmission and document handling in A.D.P. systems.** J. B. Stringer, *Computer J.*, **4,** July 1961, 161-163, disc. 163-167. The author gives his personal views on character recognition and data transmission and concludes: 'use data transmission if you can't avoid it, use character recognition if and when a useful system becomes available, and don't handle documents.'

2111 **Dynamic problems of cybernetics.** A. S. Kel'zon, *AD-257699*, 9 Feb. 1961, 1 v., $18.50. (Translated from *Gosudarstvennoye Soyuznoye Izdatel'stvo Sudostroitel'noy Promyshlennosti*, 1959, 296 pages.) Concrete problems of modern technology are used to show the application of the methods of cybernetics, as the science of the construction of systems of mechanical and electrical components to accomplish stable and purposeful operations, to the study of the synthesis of such devices. Selected problems of automatic control of motion are discussed to show the significance of the cybernetic approach to the investigation of modern engineering problems, and to develop the methods of cybernetics on the basis of concrete problems. Particular attention has been paid to the rational utilisation of modern computers, both in research and in the synthesis of schemes of automatic control of motion.

2112 **Information processing.** F. C. Frick and G. P. Dinneen. M.I.T., *AD-252199 (PB 155126)*, 15 Dec. 1960, 55p., $5.60. Contents: Digital computers; Data processing; Computer components; Pattern recognition; Analysis; Psychology. 26 refs.

2113 **Measuring the relevance of an item of information to the command of a complex man-machine system.** A. L. Schreiber, Human Sciences Research Inc., *AD-257607*, Jan. 1961, 18p., $2.60. A mathematical approach is presented on one of the most critical problems in development of command consoles and displays, i.e. the evaluation of the relevance of potential information inputs. It may be applied to any kind of proposed system to determine command information requirements when current methods may not be adequate to the task. 7 refs.

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DESIGN

2114 **Bistable systems of differential equations with applications to tunnel diode circuits.** J. K. Moser, *IBM J. Res. & Dev.*, **5,** July 1961, 226-240. In this paper, a mathematical analysis is developed for nonlinear circuits which have at least two stable steady states, and therefore are of interest as computing or memory elements. Circuits containing one or two tunnel diodes are analysed in detail as applications of the theory. The method is based on the study of a certain 'potential function' whose extrema are the steady states of the circuit and whose minima correspond to the stable switching states. This study leads to a qualitative description of all solutions in the large and results in quantitative restrictions on the parameters (R, L, C and nonlinear characteristics) which seem of practical importance. 8 refs.

2115 **Design of computer circuits using linear programming techniques.** G. H. Goldstick and D. G. Mackie, *1961 IRE Int. Convention Record,* Part 2, 224-240. A step-by-step procedure for formulating circuit synthesis problems in a manner which is amenable to solution using linear programming is presented. A method of systematising component value determination using linear programming is explained. The design equations and conditions required to synthesise a diode coupled inverter and a design procedure for achieving an optimum circuit are presented. The Simplex Method is used to determine component values, such that power dissipation is minimised. 12 refs.

2116 **Dimensionering af drivtrin for diodeafkodninger.** (Design of the driving circuit for diode decoders). B. S. Petersen, *BIT,* **1,** No. 3, 1961, 202-205. (In Danish). The complete diode decoder is a frequently used component in pulse and digital circuits. This paper presents the results of a calculation of the load of the circuits driving a decoder. An average and a worst case design are presented.

2117 **Load-sharing decoding switch for direct core storage addressing.** J. J. Guignabodet, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 84. Brief description of a load-sharing decoding switch employing magnetic cores. A pair of the switches can be used to provide coincident current selection in a core memory.

2118 **Maintenance scanner.** W. V. Wright and R. H. Larson, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 54-55. Brief account of a maintenance scanner in the program unit of a digital computer, which scanner facilitates fault location and initial program loading.

2119 **Majority gate logic improves digital system reliability.** G. Buzzell, W. Nutting and R. Wasserman, *1961 IRE Int. Convention Record,* Part 2, 264-270. This paper discusses various redundant configurations for logic and the results which led to the development of the majority gate module. The majority gate implements a 'two-out-of-three' majority decision. A given module combines a variety of logical functions with the majority gate. The use of magnetic cores and of parametrons in majority gate logic is discussed. 6 refs.

2120 **Notes on the structure of logic nets.** R. M. Stewart, *Proc. IRE,* **49,** Aug. 1961, 1322-1323. Letter presenting an elementary approach to a theory of the role of structure in logic nets and giving examples of some simple applications. The primary interest is in 'cellular' or 'honeycomb' structures which have approximately the form of 3-dimensional regular lattices, a uniform type of elementary component in a single lattice, and simply connected elementary components.

2121 **Now a ball type fluid digital computer.** *Auto. Control,* **15,** Aug. 1961, 47-50. An account of basic design principles for pneumatic digital computer circuitry using a ball-type valve developed by Kearfott.

2122 **Obtaining timing pulses from a ramp voltage.** V. C. Martin and F. L. Pratt, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 85-86. Description of a circuit which develops timing pulses from a ramp (saw-tooth) voltage, and of its use in a system for addressing a magnetic core matrix.

2123 **A systematic method for computer simplification of logic diagrams.** F. A. Rocket, *1961 IRE Int. Convention Record,* Part 2, 217-223. This paper presents systematic principles for the orderly arrangement of diagrams for the massive logic of large scale computers and which result in orderly, consistent and thoroughly indexed logic diagrams readily prepared automatically by a digital computer.

2124 **Systematically introduced redundancy in logical systems.** W. C. Mann, *1961 IRE Int. Convention Record,* Part 2, 241-263. Methods of deriving signals from a redundant group are discussed, and a systematic method for designing a redundant logical network which is near-optimum in reliability is presented. The scope is limited to logical systems which handle binary, uncoded information, sequences of digits for which there is no prior information concerning their proper content. Functionally redundant systems, i.e., systems in which all parts are turned on all the time, are considered. All systems considered have their signal processing parts separated from their interpath decision parts rather than having the two portions merged. 1 ref.

2125 **Translate with carryover.** G. A. Blaauw, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 58-60. Several byte-processing editing operations including binary-to-decimal conversion, zero elimination and punctuation insertion, and single-digit multiplication are carried out by table look-up in a specialised translation system having carryover capacity. The operation of the system is described and an example is given.

2126 **Tunnel diode threshold logic.** G. P. Sarrafian, *1961 IRE Int. Convention Record,* Part 2, 271-276. Some practical tunnel diode circuits which act as threshold logic elements are presented. Design considerations are discussed, involving the effect on the design process and on circuit operation of initial restrictions imposed by the designer such as maximum fan-in and fan-out, component and power supply tolerances, and maximum signal propagation time allowable. A brief discussion is given of the possibilities of the tunnel diode as an element in redundant logic systems and in electronic analogues of living systems. 7 refs.

2127 **About a method of constructing digital differential analyzers.** L. A. Kozharskiy, *AD-257659,* 15 Feb. 1961, 22 p., $2.60. Translated from *Voprosy Teorii Matematicheskikh Mashin,* **1,** 1958, 219-230.

2128 **Development and study of an incremental computing system.** T. D. Truitt and I. Munt, Electronic Associates Inc., *AD-253047 (PB 155354),* April 1960, 152 p., $11.50. The results of a study of an incremental computing technique are presented. The logical design of a typical integrator in a completely parallel incremental differential analyser is described. The outstanding features of this integrator are discussed; they are automatic scaling of incremental variables and multiple precision rate multipliers. The construction of two experimental integrators and the performance of tests and solution of simple equations with these units are reported in detail. 4 refs.

2129 **High speed computer system research.** E. W. Fletcher and A. L. Loeb, M.I.T., *AD-258256,* 30 April 1961, 14 p., $1.60. Contents:— Measurement and control of processes in high vacuum; Fundamental physics of the thin-film state—The polar and transverse Kerr magneto-optic effects in ferromagnetic films, Investigation of the Kerr magneto-optic effect on various materials, Optical study of switching and magnetic thin films, Measurement of the Kerr effect in nickel-iron films; Crystal algebra—The calcium silicide structure. 15 refs.

2130 **Iterative switching networks composed of combinational cells.** W. Kilmer, Montana State College, *AD-253612 (PB 155481),* 1 Dec. 1960, 45 p., $4.60. An *n*-dimensional iterative switching network consists of a number of identical logic cells uniformly interconnected through discrete information channels along each of *n* axis directions in space. This report antecedes a general treatment of such networks by focusing on the 1-dimensional case, or the case of a linear cellular array, where cells are combinational, the information channels between them are bilateral, and switching is done synchronously with unit delay through each cell. These constraints are justified by demonstrating the behavioural equivalences which exist between corresponding combinational-cell and sequential-cell networks. Three classes of networks are formed according to whether or not information flowing in one direction along the cellular array is dependent upon that flowing in the other direction. A synoptic discussion of Hennie's steady-state analysis results is given for the three classes, and the relative merit and character of the class having mutually dependent information flow is discussed. The main part of the report deals with this class as the only one which can exhibit stable-state memory properties, and proves several important theorems concerning these properties. A transposition of some of Hennie's previous results is given as a start on the transients and cycling problems. 36 refs.

131 **A property of unate switching functions with an application to logical design.** M. A. Fischler, Lockheed Aircraft Corp., *D-257869,* May 1960, 13 p., $1.60.

132 **Tunnel diode circuits for switching thin film memories.** . C. Davis, M.I.T., *AD-257015,* Jan. 1961, 81 p., $8.10. Tunnel iode circuits are investigated theoretically as a source of high-peed current pulses capable of switching thin film memories i the order of tens of millimicroseconds. Break-point models f the characteristic curve are constructed and piecewise linear nalysis is used to predict and extrapolate experimental results. hree basic circuits were chosen as drivers for various load orms and levels. These were tried in the laboratory and the esults are given. Each of these circuits utilised a novel quick-ecovery feature which was responsible for about one-half to wo-thirds of the sum of the diode peak currents necessary or a given load current. The recovery time was made equal o the pulse width, which was 20 millimicroseconds. The trig-ering delay time was approximately one-half the pulse width or all three circuits. It was concluded that tunnel diodes can e used to drive thin magnetic films in strip lines at the speed esired.

133 **Data sorting system.** Electric & Musical Industries Ltd., *B.P. 875064,* 16 Aug. 1961. This patent describes data sorting arrangements suitable for use in a digital computer. Data to be sorted is held on a magnetic drum and after sorting is stored in a magnetic core matrix. Sorting of an item is effected by comparing it with items already sorted.

134 **Microwave circuitry for data handling.** Int. Business Machines Corp., *U.S.P. 2987253,* 6 June 1961. This patent is concerned with circuitry combining phase-modulated waves representing data and a binary full adder is described as an illustrative example.

135 **Matrix addressing system.** Int. Business Machines Corp., *U.S.P. 2989732,* 20 June 1961. This patent describes a time sequence selection system for reading and writing at random addresses in a matrix of storage elements. Circuitry is described for ferroelectric capacitor and magnetic core matrices.

136 **Anti-saturation circuit for transistor amplifiers.** Thompson Ramo Wooldridge Inc., *U.S.P. 2990478,* 27 June 1961. Saturation in a single switching amplifier or a multivibrator employing transistors is prevented by a direct negative feedback circuit coupling the base and collector electrodes of each transistor.

See also :—
Applications, Electronics, Ref. 2307.
Applications, Simulation, Refs. 2355*i* and 2355*j*.

LEARNING AND PATTERN RECOGNITION

2137 **Autocorrelation function generator.** H. Baskin, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 68. Brief account of the generation of an autocorrelation function of a two-dimensional pattern (character) by a rotating raster scanning system.

2138 **Categorizing automata by W-machine programs.** C. Y. Lee, *J. Assn. Computing Mchy.,* **8,** July 1961, 384-399. A basic program structure consisting of a set of five instructions introduced by H. Wang is sufficient to describe completely the class of Turing machines. In this paper it is shown that by deleting various instructions in the set, it is possible to classify subclasses of Turing machines. A number of algorithms are given to show how internal descriptions of machines can be converted to classes of programs. 8 refs.

2139 **Character quality and scanner organization.** I. W. Merry and G. O. Norrie, *Computer J.,* **4,** July 1961, 137-143, disc. 143-144. Character quality is discussed with particular reference to recognition systems employing mapping on to a binary matrix. Examples of print and mappings are discussed together with the criteria affecting the parameters of an adequate scanning system. The paper is mainly concerned with the design parameters and performance of a flying spot scanner using a high definition cathode ray tube and photomultiplier assembly as the input transducer of a system. 1 ref.

2140 **Character recognition by digital computer using a special flying-spot scanner.** R. L. Grimsdale and J. M. Bullingham, *Computer J.,* **4,** July 1961, 129-135, disc. 135-136. This paper describes the design of a proposed flying spot scanner which enables a previously described process for recognition of spatial patterns by digital computer to be simplified and made faster. The scanner includes special coding circuits whereby the amount of processing performed by the computer is reduced. The system is designed to operate with characters produced by normal typewriters and printed characters of similar size. There is no restriction to any particular type face or size within reason, but the characters are assumed to be nearly vertical. 4 refs.

2141 **Compatibility of states in input-independent machines.** S. Ginsburg, *J. Assn. Computing Mchy.,* **8,** July 1961, 400-403. In this paper, there is found for the class of input-independent machines, the smallest integer k having the property that, if two given states do non-contradictory work for all tapes of length less than or equal to k, these two states do non-contradictory work for all tapes of any length. 3 refs.

2142 **Neural analogs.** L. D. Harmon; A. E. Brain, *Proc. IRE,* **49,** Aug. 1961, 1316-1317. Letter deploring the trend of indiscriminately equating neural analogues to biological neurons, and pointing out misconceptions in 'Self-organizing systems—a review and commentary', J. K. Hawkins, *ibid,* **49,** Jan. 1961, 31-48 (*C.A.,* **5,** April 1961, Ref. 679) and 'The simulation of neural elements by electrical networks based on multi-aperture magnetic cores', A. E. Brain, *ibid,* **49,** Jan. 1961, 49-52 (*C.A.,* **5,** April 1961, Ref. 680). There is also a comment by A. E. Brain on the letter. 9 refs. See also Ref. 2146.

2143 **A new technique in automatic character recognition.** M. B. Clowes and J. R. Parks, *Computer J.,* **4,** July 1961, 121-126, disc. 126-128. This paper is concerned with some experiments and results obtained from research on a fundamentally new approach to character recognition, with the ultimate aim of producing a reading machine capable of recognising hand-printed numerals. The method offers the possibility of overcoming basic problems concerning the positioning, orientation, size and print quality of numerals. The method involves the evaluation of an autocorrelation function of the character to be recognised. This function contains maxima corresponding to straight lines in the character, and is essentially unchanged by changes in the position and orientation of the character. Variations in the size and aspect ratio of the character also leave the function sensibly constant. 4 refs.

2144 **On a random walk related to a nonlinear learning model.** L. Kanal, *1961 IRE Int. Convention Record,* Part 2, 211-216. In this paper, some random walks related to a nonlinear learning model are derived. One specialisation of the model is shown to lead to a random walk on the real line, in which the steps the 'particle' takes to the right and to the left are not of equal size with the probability of the 'particle' taking a step to the right given given by $p_n = \frac{1}{1+e^{-x_n}}$ where x_n is the position of the particle at the end of trial n. The asymptotic distribution of p_n has all its density at $p=0$ and $p=1$. The amount of the density at $p=1$ is obtained by solving a functional equation. 11 refs.

2145 **Self-educating machines for recognition and classification of patterns.** P. A. Clavier, *Proc. IRE,* **49,** Aug. 1961, 1335. Letter suggesting a simple solution to the problem of providing a machine which will learn to classify patterns according to all possible classifications.

2146 **On self-organizing systems.** P. D. Coleman, *Proc. IRE,* **49,** Aug. 1961, 1317-1318. Letter suggesting that in 'Self-organizing systems—a review and commentary', J. K. Hawkins, *ibid,* **49,** Jan. 1961, 31-48 (*C.A.,* **5,** April 1961, Ref. 679), the author shows himself to be unfamiliar with elementary information on the biological facets of the problem of relating the nervous system to self-organising systems. Various errors in the paper are pointed out. 11 refs. See also Ref. 2142.

147 **Some comments on character recognition.** E. A. Newman, *Computer J.*, **4**, July 1961, 114-118, disc. 118-120. Some general considerations on the nature of 'interpreters' such as character recognition devices are presented and the following conclusions are drawn: (1) One should not resort to character recognition until one is very sure that one cannot reorganise one's system more efficiently without it; (2) Research should aim at finding the minimal number of features which need to be used to recognize characters, and they should be the same features which are used by man; (3) In order to minimise error and promote simplicity the actual detection apparatus should, by its inherent nature, be able to detect only the relevant features.

148 **Adaptive Program Experiment I (APE-I).** R. P. Gagan and D. Klahr, Wolf Res. & Dev. Corp., *AD-258136,* 15 May 1961, 1 v., $8.60. A detailed description is presented of the investigation of adaption by a data processing machine. The design of the experiment is developed and details of the computer programs are presented. Experimental results are listed in analysed form and conclusions are drawn regarding adaptive learning in machines.

2149 **Collected technical papers, Volume I.** Cornell University, *PB 171830,* 1 Jan. 1961, 86 p., $2.25. Contents :—

a. **Introductory note.**
b. **The perceptron: a model for brain function.** H. D. Block.
c. **Analysis of a four layer series-coupled perceptron.** H. D. Block, B. W. Knight and F. Rosenblatt.
d. **Preliminary experiments on perceptron application to bubble chamber event recognition.** C. Kesler.

53 refs.

2150 **Graphical data processing research study and experimental investigation.** A. E. Brain, A. B. Novikoff and C. P. Bourne, Stanford Research Inst., *AD-257307,* April 1961, 40 p., $4.60. A small pattern-recognition machine is being constructed capable of modification to various schemes of logic. A discussion is presented of some factors affecting the selection of machine design constants. When the pertinent limitations are imposed on the adjustable parameters, the freedom for arbitrary choice becomes very small. Fortunately, preliminary experimental results indicate that the design is practical and apparently free from mutually incompatible boundary conditions. A method is described for sampling the retina in a manner which is no longer random, but achieves a uniform distribution of probability by a specific system of selection. The results of some preliminary tests demonstrate the ability of the machine to discriminate in an environment of superimposed conflicting data. The mathematical investigation of certain theorems of integral geometry continues, and a discussion is presented of the manner in which size-invariant parameters may be constructed.

2151 **Perceptron applicability to photointerpretation (Project PICS).** A. E. Murray, Cornell Aeronautical Lab., Inc., *AD-252551 (PB 171832),* 1 Nov. 1960, 58 p., $1.50. Experiments demonstrate considerable photointerpretation ability inherent in small and simple perceptrons, and design efforts indicate the feasibility of, and a cost estimate for, several advanced models. These design efforts indicate that a versatile Mark II is logically and economically feasible, and show in detail how this may be achieved. After the experiments in image processing were completed, some time was devoted to consideration of special processing techniques and necessary contributions to perceptron development, especially for the automation of photointerpretation tasks. It is believed that the demonstrated strong inherent capabilities of the simple perceptron can be coupled to innovations in design to provide a useful automaton, and that the general nature of the necessary innovations is fairly well understood. 5 refs.

2152 **A preliminary study of spectrum analysis related to the problem of automatic speech recognition systems.** Federal Scientific Corp., *AD-251483 (PB 154347),* 30 Dec. 1960, 46 p., $4.60. The feasibility is explored of employing a spectrum analyser of the SIMORAMIC type in a comprehensive analysis programme to obtain the basic data required for the design of a practical automatic speech recognition system. Essential information-bearing parameters of speech may be presented in the form of a code. The automatic speech recognition system will operate in conjunction with a high-speed computer in real time. The ultimate applications of such a system would include: (1) the automatic translation of speech into another form of intelligence, such as its conversion into typed material; (2) program adaptation of computers as a result of vocal instructions; and (3) the use of "voice" inputs to computers for such purposes as editing, etc. 7 refs.

2153 **Research in inductive inference.** R. J. Solomonoff, Zator Co., *AD-252446 (PB 155215),* Jan. 1961, 21 p., $2.60. The principal progress made was in the discovery of what are apparently several equivalent formal solutions to the general inductive inference problem. These solutions are applicable to numerical and/or non-numerical and/or analogue and/or digital data. Any type of information that is available can be made part of the evidence upon which the inferences are made. These general induction methods were applied to several specific problems in non-numerical prediction. Some computer programs were written for the discovery of regularities in English text and any other sequence of symbols. Some work was done toward programming a computer to learn to assign descriptors to documents. Before the new inference methods were discovered, much time was spent on the problem of discovering the grammars of phrase structure languages from a body of text alone. Since then, the general inference methods have cleared up a serious point of difficulty in this problem. Another problem upon which considerable progress was made is the problem of programming a computer to improve its own inference methods. 4 refs.

2154 **A theory of adaptive systems. I. A logical theory of adaptive systems informally described (Precis).** J. H. Holland, Michigan University, *AD-256903,* May 1961, 10 p., $1.60. A theory of machine adaptive systems is developed within the framework of the theory of growing automata. Iterative circuit computers composed of iterated modules (which contain logic and delay elements) arranged in geometric arrays are discussed. The adaptive system theory is presented in four stages. (1) The basis (the iterative circuit computers); (2) the generation of automata in the geometric space of iterative circuit computers; (3) interaction of automata embedded in the space along with ranges of environments also embedded in the space; and (4) evaluation and accumulation of methods and adaptations.

2155 **Voltage comparator for use in character recognition.** Burroughs Corp., *U.S.P. 2987629,* 6 June 1961. This patent describes transistor circuitry for identifying the maximum or minimum potential of several potentials such as appear at terminals representing different characters when an unknown character is sensed.

See also :—
General, Refs. 2110 and 2112.
Elements, Ref. 2248.
Applications, Business, Ref. 2295.

MATHEMATICS

2156 **The application of the Lichtenstein-Gershgorin integral equation in conformal mapping.** C. Andersen, *BIT,* **1,** No. 3, 1961, 141-166. This paper is concerned with the Lichtenstein-Gershgorin integral equation method from the theory of conformal mapping and its programming for the Danish computer DASK. The Lichtenstein-Gershgorin integral equation is developed and some questions about the kernel and about a special system of linear equations are discussed. The program is described and some results obtained by numerical experiments are presented. It is concluded that, provided the domain which should be mapped onto the unit circle is nearly circular, the method seems to be very good. 12 refs.

2157 **An approximate method for treating a class of multiqueue problems.** M. A. Leibowitz, *IBM J. Res. & Dev.*, **5,** July 1961, 204-209. This paper considers the following problem: N queues of unrestricted length are served in cyclic order by a single server. Input to each queue is Poisson, the service time distribution may be arbitrary and a finite walking time is required by the server to go from one queue to the next. Supposing that at any queue the server serves all units which he finds when he arrives, what is the probability p that in a stationary state he finds exactly n units? A method is presented for solving this problem, which is based on the notion of a self-consistent probability distribution and is applicable to a general class of multiqueue situations. In the particular application for which the method was developed the server was a computer; the units, messages; the queues, the messages stored in a terminal; the service time, the time required to transmit a message; and the walking time, the time needed to inform a terminal that it may begin to transmit its messages to the computer for processing. 4 refs.

2158 **The approximate solution of an integral equation using gh-order Gaussian quadrature formulas.** S. M. Robinson and . H. Stroud, *Maths. of Computation,* **15,** July 1961, 286-288. his note illustrates the usefulness of certain high-order aussian quadrature formulae in a problem of approximating ie value of

$$I = \int_a^b g(x)\,\varphi(x)\,dx$$

here $\varphi(x)$ is the solution of a Fredholm integral equation,

$$\varphi(x) - \int_a^b K(x, y)\varphi(y)dy = f(x)$$

esults of calculations (on an IBM 650 and an IBM 704) oncerning flow of gas through a conical opening are discussed. refs.

2159 **Chebyshev approximations of some transcendental functions for use in digital computing.** A. J. W. Duijvestijn and A. J. Dekkers, *Philips Res. Reports,* **16,** April 1961, 145-174. Most truncated polynomial and continued fraction approximations are given to not more than 10 decimal places. For the digital computer PASCAL (Philips Automatic Sequence Calculator) with a word length of 41 bits + sign, it was desired to have more accurate approximations. This paper presents approximations accurate to 14 decimal places and describes various techniques, including direct and iterative methods, that were used. 3 refs.

2160 **Correspondence.** P. M. Woodward, *Computer J.,* **4,** July 1961, 180. Letter commenting on 'A method for the reduction of empirical multi-variable functions', C. D. Allen, *ibid,* **1,** Jan. 1959, 196-200 (*C.B.,* **3,** Feb. 1959, Ref. 387).

2161 **Divisors of Mersenne numbers $10{,}000<p<15{,}000$.** S. Kravitz, *Maths. of Computation,* **15,** July 1961, 292-293. Results of calculations on an IBM 650 are presented. 4 refs.

2162 **Error analysis of direct methods of matrix inversion.** J. H. Wilkinson, *J. Assn. Computing Mchy.,* **8,** July 1961, 281-330. In order to assess the relative effectiveness of methods of inverting a matrix it is useful to have *a priori* bounds for the errors in the computed inverses. In this paper such error bounds are determined for a number of the most effective direct methods. To illustrate the techniques fully, some of the analysis is done for floating-point computation and some for fixed-point. The error bounds are most conveniently expressed in terms of vector and matrix norms and, in the main, use is made of the Euclidean vector norm and the spectral matrix norm. 9 refs.

2163 **Expansion of hypergeometric functions in series of other hypergeometric functions.** Y. L. Luke and R. L. Coleman, *Maths. of Computation,* **15,** July 1961, 233-237. In this paper, a multiplication formula is deduced for the Gaussian hypergeometric function which generalises a statement of Chaundy and includes a multiplication theorem for the confluent hypergeometric functions due to Erdelyi. The principal result is specialised to give an expansion of the confluent hypergeometric function in series of Bessel functions. With the aid of the Laplace transform, the latter result is used to derive an expansion of the Gaussian hypergeometric function in series of functions of the same kind with changed argument. 10 refs.

2164 **A further note on approximating e^x.** D. Olivier, *Commun. ACM,* **4,** July 1961, 318. Comments on 'A note on approximating e^{x^2}', S. Lubkin, *ibid,* **3,** Dec. 1960, 649 (*C.A.,* **5,** Feb. 1961, Ref. 246).

2165 **Numerical construction of Taylor series approximations for a set of simultaneous first order differential equations.** E. S. Campbell, R. Buehler, J. O. Hirschfelder and D. Hughes, *J. Assn. Computing Mchy.,* **8,** July 1961, 374-383. Specific computational procedures are proposed for the construction of series solutions to a set of simultaneous first order ordinary differential equations subject to: (1) a restriction to moderately general functional forms which occur frequently in applications; (2) either of two sets of boundary conditions. The paper supplements conventional textbook discussions in two respects. First, available discussions do not consider series construction about a certain type of singular point which arises in important applications. Procedures are developed for this case. Second, as a preliminary step to this new case, the series construction about an ordinary point is reduced to its operational essentials. 3 refs.

2166 **The numerical solution of coupled integro-differential equations.** M. M. Pennell and L. M. Delves, *Maths. of Computation,* **15,** July 1961, 243-249. This paper reports a method for the numerical solution of simultaneous integro-differential equations of the form

$$\int_0^\infty \sum_{n=0}^{n\max} ({}_1k_n(x, g)g^{(n)}(r))dy = \sum_{n=0}^{n\max} {}_1P_n(x)f^{(n)}(x)$$

$$\int_0^\infty \sum_{n=0}^{n\max} ({}_2k_n(r, \theta)f^{(n)}(x))d\theta = \sum_{n=0}^{n\max} {}_2P_n(r)g^{(n)}(r)$$

where the asymptotic forms of $f(x)$ and $g(r)$ are known; and where ${}_1k_n$ and ${}_2k_n$ are the kernels. As an example, the solution (which has been carried out on an IBM 704) of a problem arising in neutron-deutron scattering is discussed. 4 refs.

2167 **Numerical solution of the Neumann and mixed boundary value problems by boundary contraction.** T.-S. Chow and H. W. Milnes, *J. Assn. Computing Mchy.,* **8,** July 1961, 336-358. In previous papers by the authors and R. B. Potts, a method of numerical solution of partial differential equations has been introduced and applied specifically to the Dirichlet problem for the unit circle. In this paper, this boundary contraction technique is extended to the solution of boundary value problems of the Neumann and mixed type. In addition, an alternative treatment of the Dirichlet problem is illustrated which no longer utilises the Poisson integral solution but depends on a difference approximation to Laplace's equation as the basis for development of a stable computation procedure. This approach could be generalised to apply to a broader class of differential equations. 6 refs.

2168 **Recursive computation of the repeated integrals of the error function.** W. Gautschi, *Maths. of Computation,* **15,** July 1961, 227-232. This paper is concerned with a special technique, originated by J. C. P. Miller, of computing a solution f_n of a second order difference equation

$$y_{n+1} + a_n y_n + b_n y_{n-1} = 0 \quad (n = 1, 2, 3, \ldots)$$

for $n=0(1)N$, N large, in cases where the equation has a second solution, g_n, which ultimately grows much faster than f_n. Miller's procedure consists of applying the equation in backward direction,

$$y_{n-1} = -b_n{}^{-1}(a_n y_n + y_{n+1}) \quad (n = \nu-1, \nu-2, \ldots, 1; \nu > N)$$

starting with the initial values $y_{\nu-1} = \alpha$, $y_\nu = 0$, where α is any real number $\neq 0$. After a detailed description of Miller's procedure, paying special attention to the error term, the procedure is applied to the computation of the repeated integrals of the error function

$$i^n \operatorname{erfc} x = \frac{2}{\sqrt{\pi}} \int_x^\infty \frac{(t-x)^n}{n!}\, e^{-t^2}\, dt \quad (n = 0, 1, 2, \ldots),$$

$$i^{-1} \operatorname{erfc} x = \frac{2}{\sqrt{\pi}}\, e^{-x^2}$$

and it is shown that the process converges for any positive x, as $\nu \longrightarrow \infty$. Estimates are developed of how large ν must be taken to ensure any prescribed accuracy. 9 refs.

2169 **Solution of the von Mises boundary layer equation using a high-speed computer.** A. R. Mitchell, *Maths. of Computation,* **15,** July 1961, 238-242. In the problem of incompressible boundary layer flow along a semi-infinite flat plate against an adverse pressure gradient, the non-dimensional free stream velocity is taken to be $u_1=1-x$, where the plate lies along the positive part of the x-axis. The von Mises equation for incompressible flow is, in the usual non-dimensional notation

$$\frac{\partial z}{\partial x} = u \frac{\partial^2 z}{\partial \psi^2} \quad \text{where } z = u^2{}_1 - u^2.$$

In this paper, a finite difference form of the von Mises equation is presented which is particularly suitable for exploring the region near the plate and calculations carried out on a DATATRON 205 are discussed. 8 refs.

170 **Some computational results on "two-line" iterative methods r the biharmonic difference equation.** S. V. Parter, *J. Assn. mputing Mchy.*, **8,** July 1961, 359-365. The author has eviously developed useful methods of solving two-line equa-ns and obtained estimates from above on λ_R, λ_L and λ_E, the ectral radii of the iteration matrices for the Richardson imultaneous displacement), Liebmann (successive displace-ent) and Extrapolated Liebmann (over-relaxation, successive splacement) schemes respectively. This paper discusses some sults of actual computation experiments (performed on an 3M 650) to obtain the true values of these eigenvalues in veral cases. The results are compared with the estimates. refs.

171 **Stability analysis and integration of the viscous equations f motion.** L. Filler and H. F. Ludloff, *Maths. of Computation,* **5,** July 1961, 261-274. Techniques are established for the umerical solution of the time-dependent, one-dimensional quations of motion of a viscous, heat-conducting fluid. The quations of motion are approximated by suitable finite differ-nce equations and the stability of the difference equations is nvestigated by using von Neumann's error analysis. Both xplicit and implicit finite difference schemes are studied and sed to compute the formation of a shock wave from a finite mplitude compression pulse. Computations were carried out n an IBM 650. 5 refs.

2172 **On a theorem of Mann on Latin squares.** R. T. Ostrowski and K. D. Van Duren, *Maths. of Computation,* **15,** July 1961, 293-295. An account of the use of a UNIVAC M-460 to find an example indicating that the following theorem of Mann is the best possible of its type for order 10: If a Latin square L of order $4t+2$ has a $(2t+1) \times (2t+1)$ block with as many as $(2t+1)^2-t$ cells containing digits in a list of $2t+1$, then there exists no Latin square orthogonal to L. 4 refs.

2173 **Zeros of nonlinear functions.** R. W. Klopfenstein, *J. Assn. Computing Mchy.*, **8,** July 1961, 366-373. This paper presents a method of reformulating the problem of finding zeros of nonlinear functions in terms of the solution of simultaneous ordinary differential equations. The application of the method to the finding of the zeros of the function

$$f(x,a)=\sin[(a+1)x]-\frac{\sqrt{2}}{4}(a+2)ax\cos(x)$$

is described.

2174 **On fitting a linear trend and testing independence when the residuals form a Markov process.** V. K. Murthy, Stanford University, *AD-250324 (PB 154796),* 22 Nov. 1960, 17 p., $1.60. A study was conducted on the problem of fitting a linear trend when the residuals are serially correlated according to a first order Markov scheme. An iteration method for solving the maximum likelihood equations is proposed and an explicit criterion for the convergence of the iteration process is obtained. 4 refs.

2175 **Time response characteristics of linear networks and transformation methods in network synthesis.** J. D. Brule and B. P. Shah, Syracuse University, *AD-257822,* 16 June 1961, 51 p., $5.60. An attempt is made to use the criterion of least-squared error to determine analytically the shifts of the locations of the poles and residues of a transfer function in order to meet a time domain specification. A first approximation is obtained with the help of existing methods, and successive steps are carried out using the first two terms of the Taylor Series expansion of the first approximation. In the process, orthogonal vector functions are formed by linear combinations of the partial derivative functions. The use of FORTRAN for programming the problem for the IBM 650 is illustrated. 13 refs.

See also :—
Design, Ref. 2114.
Techniques, Refs. 2184 and 2189.
Applications, Physics, Ref. 2352.

TECHNIQUES

2176 **On the accuracy of floating point computers.** O. Amble; J. V. Garwick, *BIT,* **1,** No. 3, 1961, 220-222. Note referring to 'The accuracy of floating point computers', J. V. Garwick, *ibid,* **1,** No. 2, 87-88 (*C.A.*, **5,** June 1961, Ref. 1143), and giving a further analysis. There is also a brief reply by the author.

2177 **Algorithms.** *Commun. ACM,* **4,** July 1961, 319-322. Consists of the following algorithms (in ALGOL 60) and remark:—

a. **Algorithm 61: Procedures for range arithmetic.** A. Gibb, p. 319-320. Procedures are given for the fundamental operations in range arithmetic.

b. **Algorithm 62: A set of associate Legendre polynomials of the second kind.** J. R. Herndon, p. 320-321. This procedure places a set of values $Q_n^m(x)$ in the array Q [ ] for values of n from 0 to nmax for a particular value of m and a value of x which is real if ri is 0 and is purely imaginary, ix, otherwise. R [ ] will contain the set of ratios of successive values of Q.

c. **Algorithm 63: Partition.** C. A. R. Hoare, p. 321. I and J are output variables, and A is the array (with subscript bounds M:N) which is operated upon by this procedure. Partition takes the value X of a random element of the array A, and rearranges the values of the elements of the array in such a way that there exist integers I and J with the following properties:

$$M \leqq J < I \leqq N \text{ provided } M < N$$
$$A[R] \leqq X \text{ for } M \leqq R \leqq J$$
$$A[R] = X \text{ for } J < R < I$$
$$A[R] \geqq X \text{ for } I \leqq R \leqq N$$

d. **Algorithm 64: Quicksort.** C. A. R. Hoare, p. 321. A very fast and convenient method of sorting an array in the random access store of a computer.

e. **Algorithm 65: Find.** C. A. R. Hoare, p. 321-322. This procedure will assign to A[K] the value which it would have if the array A[M:N] had been sorted. The array A will be partly sorted, and subsequent entries will be faster than the first.

f. **Algorithm 66: Invrs.** J. Caffrey, p. 322. Inverts a positive definite symmetric matrix t, of order n, by a simplified variant of the square root method. Replaces the $n(n+1)/2$ diagonal and superdiagonal elements of t with elements of t^{-1}, leaving subdiagonal elements unchanged.

g. **Algorithm 67: Cram.** J. Caffrey, p. 322. This procedure stores, via an unspecified input procedure, the diagonal and superdiagonal elements of a square symmetric matrix e, of order n, as a pseudo-array of dimension $1:n(n+1)/2$.

h. **Remark on Algorithm 53: Nth roots of a complex number.** C. W. Nestor, p. 322. Suggests a time-saving modification to the algorithm published in *ibid,* **4,** April 1961, 180 (*C.A.*, **5,** Sept. 1961, Ref. 1885*m*).

2178 **Backlash simulation in d.c. electronic analogue computers.** J. C. Earls, *Ann. Assn. Int. Calcul Analogique,* **3,** July 1961, 110-113. Dynamical systems, mechanical or electrical, may contain a component which possesses a backlash (or hysteresis) characteristic. In this paper, this characteristic is considered to be discontinuous and double-valued and the dynamical system is therefore inherently nonlinear. Two analogue circuits for the simulation of this discontinuous double-valued function are analysed and their relative advantages and limits of performance are considered. A harmonic study of one of the circuits is described, in which a harmonic signal was applied to the input and the output observed on a cathode ray oscilloscope. 6 refs.

2179 **Ein Beispiel für die Zusammenarbeit zwischen einer Grossrechenanlage und einer Kleinanlage.** (An example of cooperation between a large computing installation and a small installation). H.-J. Zindler, *Elektronische Datenverarbeitung,* No. 3, 1961, 103-105. (In German) English summary: 'The cooperation of a large scale data processing system [IBM 7070] with a small size computer [IBM 1401] serving as off-line equipment is discussed. A special application (off-line printing of results on magnetic tapes produced by the large scale computer) is used to show the problems in the most efficient distribution of the processing workload to these two different systems. Besides this, the efficiency of the small size computer is compared with that of usual off-line equipment (off-line printers, etc.).'

180 **Design of numerical filters with applications to missile data processing.** J. F. A. Ormsby, *J. Assn. Computing Mchy.*, July 1961, 440-466. A discussion of the process of numerical (digital) filtering is presented together with formulae for a particularly simple but effective design. The error is discussed in terms of the quantity $\varepsilon(\lambda, N)$ with λ the normalised frequency and N the number of filter weights. Later empirical design curves with ε as a parameter are given. In addition, the effect of allowing slope discontinuities in the filter transfer function is noted. Next, the problem of trend type errors and their elimination by the inclusion of additional constraints on the filter weights is included. Designs for high-pass, band-pass and quadrature filters, with a comparison of two band-pass design approaches, are given. Specific applications, in the field of missile telemetry data processing, are given to illustrate the effect of the filtering process as well as the various ways filters can be used in processing digital data. 9 refs.

181 **A divisionless method of integer conversion.** W. K. Clarkson and B. M. Prince, *Commun. ACM*, **4**, July 1961, 315-316. A simple method is presented for converting base b_1 integers to base b_2 integers using base b_1 arithmetic. It has the advantages that it does not require a division operation, the procedure terminates automatically when the last base b_2 digit has been found, and it is completely general for any b_1, b_2 and computer word length. The primary application is to the conversion of binary to binary decimal in a computer lacking a division instruction.

182 **An efficient scheme for the co-diagonalization of a symmetric matrix by Givens' method in a computer with a two-level store.** J. S. Rollett and J. H. Wilkinson, *Computer J.*, **4**, July 1961, 177-180. The Givens' process, as it is commonly performed, requires simultaneous rapid access both to rows and to columns of the matrix. It is shown that by running in parallel the various rotations which produce a row of zeros it is possible to reduce the number of scans of the matrix by a factor of order n. The scanning is then less than that for Householder's process which is, however, faster in other ways. The number of multiplications and the rounding errors for the modified Givens' process are the same as when the rotations are carried out sequentially, but tests of the method on Mercury show an overall gain of speed by a factor of 7 for matrices of order 96. 5 refs.

183 **An experimental computer program for hypothesis selection.** M. Kochen, *Commun. ACM*, **4**, July 1961, 323. Brief description of an algorithm for finding the characterisation of a class of objects on the basis of a randomly ordered sequence of labeled individual objects—some members of the class, some not.

184 **Factorization of factorials.** S. Comét, *BIT*, **1**, No. 3, 1961, 167-176. If factorials enter into product-quotient expressions, not allowing approximate calculation, the factorisation into powers of primes is recommended. This paper describes a program for this process, based on a known formula, which should be applied differently according to whether the primes are large or small. It is shown how to distinguish between large and small primes in order to minimise the computing time. 1 ref.

185 **The fixed point division in GIER.** T. Krarup, *BIT*, **1**, No. 3, 1961, 200-201. The abundance of registers in the GIER computer permits the use of a method of division much faster than the method of nonrestoring division usually employed. The method, which is briefly described and discussed in this paper, uses five registers: one 10-bit register with downward counting capability, two 41-bit registers and two 40-bit registers.

186 **An iterative method for inversion of power series.** J. N. Bramhall, *Commun. ACM*, **4**, July 1961, 317-318. If the power series

$$y = x + a_2x^2 + a_3x^3 + \quad . \quad . \quad . \qquad (1)$$

is absolutely convergent in some neighbourhood of $x=0$ then the inverse series

$$x = y + b_2y^2 + b_3y^3 + \quad . \quad . \quad . \qquad (2)$$

is unique and absolutely convergent in some neighbourhood of $y=0$. This inverse can conveniently be found by writing (1) in the form

$$x = y - a_2x^2 - a_3x^3 - \quad . \quad . \quad . \qquad (3)$$

and then successively substituting the right-hand side of (2) for x throughout the right-hand side of (3). An algorithm is described which carries out the successive substitutions in such a way that the coefficients b_i in (2) are computed in order. Results of a FORTRAN program executed on an IBM 7090 are given. 3 refs.

2187 **Locating the largest word in a file using a modified memory.** E. J. Gauss, *J. Assn. Computing Mchy.*, **8**, July 1961, 418-425. An algorithm is presented for locating the largest word in a file using a memory which is modified so that a given bit in all words can be readout in one operation. With this algorithm a time gain over a conventional system can be obtained equal to the quotient of the number of words divided by the number of bits. Algorithms are also given for locating words greater or less than an arbitrary 2^n.

2188 **Minimum polarized distance codes.** M. P. Marcus, *IBM J. Res. & Dev.*, **5**, July 1961, 241-248. This paper is concerned with the reliability of codes and shows how, for a given number of bits per character and a given minimum distance, the probability of undetected error in an asymmetric channel may be reduced by many orders of magnitude merely by the proper selection of coded characters. For a given minimum distance, an optimum selection of characters requires, as nearly as possible, the same number of 'one' and 'zero' bit failures to change one character to another. The concept of *polarized distance* is introduced; the *polarized distance* between two coded characters is the number of bits *of each type* that must change in one character so that the other character results. The polarized distance is thus made up of two numbers whose sum is equal to the *distance* (i.e. the total number of bits that must change) between the characters. It is shown how the probability of undetected error is related to the *minimum distance* of a code only in a symmetric channel, while it is related to the *minimum polarized distance* in both symmetric and asymmetric channels. 3 refs.

2189 **A modified Givens method for the eigenvalue evaluation of large matrices.** D. E. Johansen, *J. Assn. Computing Mchy.*, **8**, July 1961, 331-335. The first step in Givens procedure for isolating the eigenvalues of a real $n \times n$ symmetric matrix A involves reduction of A to tri-diagonal form. The usual methods for accomplishing this reduction require rapid random access to the elements of A; otherwise for large matrices the computer time required to search (say on magnetic tape) for these elements may be much longer than the time required for actual computation. This paper is concerned with a basic reordering of operations which avoids this difficulty and makes efficient use of auxiliary magnetic tape memory for primary storage of matrices which are too large to handle in high speed storage. This modified Givens method has been successfully programmed for the Burroughs 205. 9 refs.

2190 **Obtaining the frequency response of physical systems by analogue computer techniques.** G. W. Ogar, *1961 IRE Int. Convention Record*, Part 2, 196-210. This paper is concerned with a method of obtaining the frequency response of a physical system by direct representation of the transfer function on an analogue computer. The technique is feasible since the transfer function of any linear system may be expressed as a complex number. The method proposed is to generate polynomials in the machine variable by means of integrators wherein the constant coefficients can be set by means of initial conditions on the integrators. Resolvers are then employed to form the magnitude and phase angle of the complex number. By plotting the imaginary part of the complex number versus the real part, the Nyquist plot is obtained and by plotting the magnitude of the complex number versus frequency and the phase angle versus frequency, the two Bode plots are obtained. Several examples of the application of the technique are given. 1 ref.

2191 **The reduction of a matrix to codiagonal form by eliminations.** C. Strachey and J. G. F. Francis, *Computer J.*, **4**, July 1961, 168-176. This paper describes the use of elementary transformations to reduce a matrix first to almost triangular form and then from this to codiagonal form. It is proved that the second stage of the reduction is exactly equivalent to the method of Lanczos. The relationship that the codiagonal form bears to the almost triangular matrix and to the original matrix are briefly discussed. Mention is made of various points concerning errors and accuracy. A program which has been used on Pegasus is presented and discussed. 4 refs.

2192 **Solution of tridiagonal matrices.** R. C. Wenrick and A. V. Houghton, *Commun. ACM*, **4**, July 1961, 314. Brief note giving extremely simple recurrence relations for the solution of tri-diagonal matrices such as occur in steady and nonsteady problems of heat transfer.

2193 **Theory of files.** L. Lombardi, *Commun. ACM*, **4**, July 1961, 324. Work at the University of California, Los Angeles, on the development and application of the theory of files is outlined. 7 refs.

2194 **BAND-1: a data reduction program for the IBM-704.** B. L. Anderson, A. P. Hemphill et al, Bettis Atomic Power Lab., *WAPD-TM-216,* May 1961, 53 p., $1.25.

2195 **A power-spectrum program for the IBM 650 computer.** S. E. Smith, University of Texas, *AD-257627,* 15 Oct. 1960, 18 p., $1.60. The power-spectrum program described in this report uses for its input the autocorrelation function, as calculated by the program described in DRL AF Technical Memorandum No. 51. The spectrum program prepares a table of the cosines which will be needed and then generates appropriate look-up instructions for the cosines during the computation. This is considerably faster than recomputing each cosine as needed. The output of the spectrum program gives the frequency interval, the raw spectrum, the Hammed and Hanned spectra, and the cumulative or integrated version of these three spectra.

2196 **A study of incremental computation by difference equations.** F. B. Hills, M.I.T., *AD-160015 (PB 156333),* May 1958 (Released to public 16 June 1961), 114 p., $9.60. The shortcomings of previous computation approaches to computers can be overcome by working with a description of the computation process which is based on a difference-equation formulation. This description is used here to investigate the characteristics of incremental integration. In particular, the causes and propagation of truncation and round-off errors are investigated. Also investigated are two other errors: (1) drift due to the variable to integration changing from increasing to decreasing or vice versa, and (2) method errors, so-called because of their direct connection with the method of solution. The investigations cover not only the magnitude and causes of these errors, but means are presented for reducing their effect or eliminating them altogether. 19 refs.

See also :—
Mathematics, Refs. 2156, 2159, 2169, 2170 and 2175.
Applications, Simulation, Refs. 2355*e* and 2355*h*.

ACCESSORIES

2197 **An analytical expression for describing the write process in magnetic recording.** T. C. Ku, *Proc. IRE,* **49,** Aug. 1961, 1337-1338. Letter describing analytically the writing process, including self-demagnetisation, in magnetic recording on a thin magnetic material. An expression is developed which enables the magnetisation in the recording medium after writing to be determined in relation to the geometry of the recording head, the variation of the gap field strength with time, and the hysteresis of the magnetic medium. 2 refs.

2198 **Binary coded decimal to binary translator.** R. A. Anderson and D. T. Brown, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 56-57. Description of a translator which makes a straight binary memory compatible with a binary coded decimal computing system.

2199 **Data collection and transmission.** E. P. G. Wright, *Computer J.,* **4,** July 1961, 103-107, disc. 108-109. In this paper a method (in which use could be made of a digital computer) is proposed for evaluating the effectiveness of different error detection and error correction arrangements for data transmission systems. In order to limit the amount of measurement necessary, the method involves a theoretical approximation assuming a random distribution of 'errors per block', and the determination, from measurements of an adjustment factor depending on the ability of the detection code to recognise the actual distribution of errors rather than the assumed random distribution. The paper also describes some very simple equipment which could be used for low speed collection of data over telephone lines. 4 refs.

2200 **A data transmission survey.** P. A. Long, *Computer J.,* **4,** July 1961, 95-98, disc. 99-102. The results are analysed of an investigation conducted by the Inland Telecommunications Department of the General Post Office during 1960. The object of the investigation was to determine the future needs for data transmission facilities with particular emphasis on the type of lines required in the immediate future. The investigation was carried out by sending questionnaires to all known and potential users of computers. 3 refs.

2201 **Design and operation of a high speed increased capacity magnetic drum.** R. R. Schaffer and D. W. Gill, *1961 IRE Int. Convention Record,* Part 2, 128-134. This paper presents magnetic drum memory techniques directed toward satisfying data storage requirements between high speed core arrays and low speed disc and tape files. With these techniques the capacity range of the drum extends into the megabit region with data processing speeds of 750 Kc/s. Qualitative design concepts are developed and their usefulness demonstrated, both in the evaluation of the interaction of magnetic recording with solid state circuit logic and their effects on magnetic drum memory performance. A new type ('tear drop') of magnetic head structure was developed, which used in conjunction with a 30 microinch cobalt nickel drum surface results in a recording density of 400 bits per inch at 0.0004 inch head-drum spacing and a 50 ma write current. This arrangement permits the use of fixed mounted magnetic heads and low current transistor drivers and switching diodes. A differential type sense amplifier is described which has a frequency response from dc to 1 Mc/s. Solid state circuits are shown for the spacial selection of the recording heads and block diagrams are given for the input/output translators. 8 refs.

2202 **Drum loader.** B. T. Colandene and G. E. Yingling, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 32. Description of a system for loading the timing tracks of a magnetic drum with a full complement of equally spaced timing pulses.

2203 **A harmonic analysis of saturation recording in a magnetic medium.** B. Kostyshyn, *1961 IRE Int. Convention Record,* Part 2, 112-127. In storing digital information on a magnetic medium, it is common practice to use a single write-read head coupled with saturation recording techniques. It is difficult to determine experimently the contribution of individual parameters to the system, and in this paper a theoretical equation is developed describing the output of a system in terms of the physical, magnetic and electrical parameters of the system. The equation has been programmed for the IBM 704. When applied to an experimental NRZ system, excellent agreement between observed and calculated results was obtained. The phenomena of 'peak' or 'phase' shift and amplitude shift occurring for an isolated pair of adjacent 'ones' at high bit densities is demonstrated and discussed. The calculated dependence of the zero-to-peak output and the peak-and-amplitude shifts is shown for variations in the thickness, retentivity, coercivity and squareness of the storage medium, and for variations in the write current, the head-to-medium spacing and the pole gap dimensions. 18 refs.

2204 **The impact of computers on documentation.** A. S. Douglas, *Computer J.,* **4,** July 1961, 145-147, disc. 147-149. This paper presents some general considerations regarding methods of keeping documentation to a minimum and of improving its layout both for input to a computer and for use when produced as output by a computer. 2 refs.

2205 **Magnetic core converts voltage to pulse duration.** V. A. Van Praag, W. Stanke and D. Van Mindeno, *Control Engng.,* **8,** Aug. 1961, 87-88. Description of an analogue-to-digital converter in which a low-level input voltage sets flux density in a magnetic core. Switching action then generates a pulse with a time duration proportional to input level. A count of clock pulses for the time interval yields a number of pulses equivalent to the input voltage.

2206 **Packing mode control.** R. R. Bender and D. J. Galage, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 61-63. An 8-channel magnetic tape provides 8 bit values in parallel from a reading head. This group can be examined by circuitry in several modes, i.e., decoded several different ways. Thus, in unpacked mode recording an alphameric code of six bit values may be used and there is only one character per bit group; in packed mode recording a numerical code of four bit values may be used so that there are two binary-decimal digits in each 8-bit group. Since a particular bit structure, such as 0011 0110 is valid both in alphameric (F) and numeric (3, 6), it is necessary to provide mode control arrangements to properly decode any 8-bit group. Such arrangements are described.

2207 **Present and future facilities for data transmission.** M. B. Williams, *Computer J.,* **4,** July 1961, 88-93, disc. 93-95. This paper gives a broad survey of the facilities available for data transmission from the point of view of a telephone engineer. The different problems of private point-to-point and public switched circuits of telegraph and telephone type are discussed. The possibilities of using wideband channels corresponding to standard assemblies of telephone channels are reviewed.

2208 **Problems in digital recording.** L. A. Ormord, *Instr. & Control Systems,* **34,** Aug. 1961, 1430-1433. This article is concerned with digital recording on magnetic tape and discusses such matters as amplitude errors, skew errors, distortion, signal dropouts, and the storing and handling of tape. 6 refs.

2209 **Rotating recording head.** D. H. Cronquist, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 13-14. Description of arrangements whereby a magnetic recording head is rotated relative to a stationary record surface and is moved into operative air bearing relation with the record surface by a combination of mechanical and centrifugal forces.

2210 **Stabilized synchro to digital converter.** M. Masel and D. H. Blauvelt, *1961 IRE Int. Convention Record,* Part 2, 175-181. The use of a digital computer in a real time, airborne control system creates the requirement for preparing sensor information in a form that can be accepted by the computer. This paper is concerned with the use of autosyn resolvers as the input transducers. The resolvers have their stators excited with quadrature voltages and the shaft position information is contained in the phase of the rotor output voltages. The phase of each rotor voltage is compared with the phase of a fixed reference voltage, thus defining a time interval. Clock pulses are gated into a counter during this time interval, producing a binary number proportional to shaft position. 1 ref.

2211 **Transducer supporting shoes.** H. P. Braen and H. H. Burk, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 12. Brief description of an arrangement of shoes floating on a fluid film on the surface of a magnetic drum to position write and read tranducer assemblies near the surface of the drum.

2212 **A versatile new data entry device: the Director Card System.** C. E. Faulkner, *Control Engng.,* **8,** Aug. 1961, 97-100. Spiegel Inc., operate a large mail order house in Chicago where records of inventory on 120,000 catalogue items are maintained at rates up to 50,000 transactions per hour on an IBM 7070 on merchandise items which require the entry of fixed descriptive data (such as size, colour, etc.) in English on the sales slips. This article describes a versatile data entry device, the Director Card System, which has been developed by Ferranti-Packard Limited of Toronto, Canada for use by Spiegel's. The director card has the fixed descriptive data printed on the front for the operator and the same data is printed on the back in a digital code (in the form of black and white lines). The coded data is photoelectrically sensed by the card reader of the Director Card System which also includes a printer, a paper tape punch, an item counter and a solenoid actuated adding machine. The paper tape is subsequently converted to a magnetic tape for feeding into an IBM 7070 for processing in the merchandise inventory control system.

2213 **The Computer Data Format Translator.** R. Goldsteen, David Taylor Model Basin, *AD-257335,* May 1961, 25 p., $2.60. This report serves as an introduction to the Computer Data Format Translator. The CDFT performs three basic types of information translations; computer tape to computer tape, analogue to computer format, and straight binary to computer format. Computer format is the format of either Univac or IBM. The variations of each translation which provide the 14 major operation modes of the unit are discussed. The principles of operation and sample patch board connections are given. Detailed block layouts and output tape formats are provided for the reader to follow the path of the data through the system.

2214 **Operation of the diode matrix coder.** W. A. Bellmer, Polytechnic Inst. of Brooklyn, *AD-234297 (PB 155709),* 16 Dec. 1959, 38 p., $3.60. Improvements were made on the preliminary design considerations for a diode-matrix transducer, and a medium size device was constructed. The physical characteristics of this device with associated input producers and output recorder are described to serve as a maintenance reference. Programming methods are provided for each function of the device and examples are given. The coder performs all functions reliably except the decoder, which presents problems due to a form of feedback produced by the program. 3 refs.

2215 **SC 4020 Microfilm Recorder programming manual I.** R. Mejia, P. Battey et al, David Taylor Model Basin, *AD-257604,* June 1961, 46 p., $4.60. The operation of the SC 4020 Microfilm Recorder on-line with the IBM 704 at the Applied Mathematics Laboratory is defined. The function and command structure of the various components of the recorder are described, and engineering features of the SC 4020 and of the CHARACTRON tube itself are included. The addition of a special subroutine package to the executive routine which controls the sequential execution of programs in the IBM 704 is covered. These basic subroutines for printing, plotting, and service functions are described, including the necessary calling sequences with samples. The necessary modifications to the command structure for off-line use of the SC 4020, including those required for use with the IBM 7090, are indicated.

2216 **Character display.** Int. Telephone & Telegraph Corp., *U.S.P. 2987715,* 6 June 1961. Alpha-numeric characters are displayed on a cathode ray tube in the form of a pattern of dots illuminated under control of diode matrices.

2217 **Data transfer system.** Research Corp., *U.S.P. 2988735,* 13 June 1961. A data transfer system employing a magnetic drum buffer is described in some detail.

2218 **Binary/decimal converter.** Int. Business Machines Corp., *U.S.P. 2989235,* 20 June 1961. Circuitry operable to convert from pure binary to decimal notation or from decimal to pure binary notation is described.

2219 **Magnetic drum store.** Int. Business Machines Corp., *U.S.P. 2989731,* 20 June 1961. Circuitry is described in some detail for a magnetic drum storage unit capable of storing variable length records.

2220 **Analogue-to-digital converter.** R. M. Roppel, *U.S.P. 2993201,* 18 July 1961. An analogue-to-digital converter is described in which voltage comparison is effected by means of a cathode ray tube co-operating with a mask and a photocell.

2221 **Digital-to-analogue converter.** U.S. Secretary of the Navy, *U.S.P. 2993202,* 18 July 1961. A digital-to-analogue converter of improved accuracy, employing diode switches, is described.

See also :—
General, Ref. 2110.
Learning and Pattern Recognition, Ref. 2152.
Elements, Ref. 2248.
Applications, Business, Ref. 2295.

ELEMENTS

2222 **Adder circuit.** O. J. Bedrij, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 36-39. Description of an adder circuit in which the delay time due to carry propagation is reduced to a minimum. The problem of carry propagation delay is overcome by dividing the digital positions of the addend and augend into several groups. Each group has a subaugend and a corresponding subaddend. During the first step in the operation, the subaugends and corresponding subaddends are simultaneously added twice to produce two subsums. One addition assumes that there is a carry into each group. The other addition assumes that there is no carry into each group. During the second step in the operation, the correct subsums for all groups are simultaneously selected.

2223 **Complementary emitter follower storage circuit.** J. L. Walsh, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 73-74. Description of a transistorised circuit operating at low voltage levels and having a delay time from input to output of two nanoseconds, which employs a twin tunnel diode pair for bistable storage.

2224 **Current mode NAND.** I. Antipov, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 78-79. Description of a multistage arrangement of current mode NAND circuits, comprising two conventional diode AND circuits and two transistor inverters, which employs a tunnel diode in each stage. The base electrode of each transistor is driven by the output of the AND circuit for that stage. This is effected through a voltage translating device, such as a Zener diode and a tunnel diode, which shunts the base electrode. The use of a tunnel diode in each stage enables the circuit to operate substantially faster by preventing operation of the transistors in a saturating manner, thus eliminating the delays inherent in such operation.

2225 **Double register.** M. F. Heilweil, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 66-67. Description of a register which permits new information to be entered into it at the same time that old information is being read out.

2226 **Esaki diode latch circuit.** J. Dieffenderfer, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 81-82. Description of a latch circuit employing two capacitor-coupled Esaki diodes.

2227 **High-speed analogue multiplier.** D. L. A. Barber, *Control,* **4,** Aug. 1961, 95. Description of a new circuit for an analogue multiplier developed at the National Physical Laboratory. The circuit uses transistors to produce a rectangular wave-form of amplitude proportional to one variable and width proportional to a second variable. The product of the two variables is obtained by integrating this wave-form.

2228 **Latch circuit.** M. P. Xylander, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 83. Description of a secondary storage device for use in conjunction with a stage of a magnetic core register, which includes two transistors connected in a latch circuit.

2229 **On the linear circuit aspects of cryotrons.** P. M. Chirlian and V. A. Marsocci, *Proc. IRE,* **49,** Aug. 1961, 1326. Letter giving a more accurate expression for the gate resistance of a cryotron in the transition region than that given by M. L. Cohen in 'Thin film cryotrons, Part III—An analysis of cryotron ring oscillators', *ibid,* **48,** Sept. 1960, 1576-1582 *(C.A.,* **5,** March 1961, Ref. 532).

2230 **Magnetic memory cores.** M. Whitmer, *Instr. & Control Systems,* **34,** Aug. 1961, 1427-1429. Introduction to the basic principles of magnetism, magnetic core properties, testing procedures, physical characteristics, core operation and memory arrays.

2231 **A 0.7-microsecond ferrite core memory.** W. H. Rhodes, L. A. Russell, F. E. Sakalay and R. M. Whalen, *IBM J. Res. & Dev.,* **5,** July 1961, 174-182. This paper describes the design and performance of a newly developed magnetic core memory with a cycle time of 0.7 microseconds. A two dimensional array organisation and partial switching of toroidal cores is employed in the design of this low power, high speed memory which uses two cores to store each bit of information. A particular feature of the memory is the combination of a current-steering diode matrix and a load-sharing magnetic core matrix switch in an economical and high performance drive system. The operating memory has a storage capacity of 73,728 bits and executes instructions reliably up to a repetition rate of 1.47 Mc/s. 5 refs.

2232 **Parallel adder error checking system.** S. F. Anderson, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 52-53. Description of arrangements for checking input signals gated from two registers and applied in parallel to a high speed carry generator, for gating errors.

2233 **A potential microwave computer element.** R. W. Couch, A. F. Rashid and R. Spence, *Proc. IRE,* **49,** Aug. 1961, 1338-1339. Letter describing a device which might be used for performing logic and computing operations at speeds reaching the microwave range using other than pulse operation. The device is a bistable oscillator frequency script system employing a tunnel diode as the active element. 2 refs.

2234 **Pulse generating circuit.** D. R. Daykin, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 87-88. Description of a pulse generating circuit which supplies pulses of high peak current and short duration to loads having reactive components. The circuit includes a transistor and a magnetic core which functions as an autotransformer as well as a switch.

2235 **Read only memory.** F. A. Ordemann, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 23-24. Description of a low-cost, semipermanent data storage system in which static sensing of a punched card is effected with the aid of a capacitor matrix.

2236 **The silicon cryosar.** H. Izumi, *Proc. IRE,* **49,** Aug. 1961, 1313-1314. Letter reporting the characteristics of the silicon cryosar developed at the Nippon Telegraph and Telephone Public Corporation, Tokyo. 3 refs.

2237 **Size effects in thin superconducting indium films.** A. M. Toxen, *Physical Rev.,* **123,** 15 July 1961, 442-446. This paper presents the results of experimental investigation of size effects in superconductors. Measurements were made of normal state electrical resistance, critical temperature for superconductivity and critical magnetic field. From these quantities, residual resistivity, effective film thickness and penetration depth are obtained. Indium films ranging in thickness from 650 to 126,000 Å were used. 35 refs.

2238 **Synchronized delay circuit.** G. L. Clapper, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 72. Description of a transistor-diode circuit using inductance for the main storage element, which produces an output pulse delayed by one bit from the input pulse. The circuit operates under control of a synchronising pulse train up to 15 Mc/s.

2239 **Theory and practice of Hall effect multipliers.** G. S. Glinski and J. P. Landolt, *1961 IRE Int. Convention Record,* Part 2, 143-163. This paper discusses in some detail the employment of the Hall effect in a purely electronic, wide frequency band, accurate multiplier for analogue computers. 18 refs.

2240 **Thin-film cryotrons.** V. L. Newhouse and H. H. Edwards, *Proc. IRE,* **49,** Aug. 1961, 1318-1319. Letter referring to 'Thin-film cryotrons', C. R. Smallman, A. E. Slade and M. L. Cohen, *ibid,* **48,** Sept. 1960, 1562-1582 *(C.A.,* **5,** March 1961, Ref. 532), and pointing out that the implication in that paper that magnetically unshielded crossed-film cryotrons do not always become superconducting and cannot be used reliably to store circulating currents is not correct. 3 refs.

2241 **Three-level inverter using a two-emitter transistor.** P. H. Bardell and A. J. Gruodis, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 80. Description of a circuit which accepts a three-level input signal and provides an inverted three-level output signal. A two-emitter transistor, capable of conducting through either one or both of the emitters, is employed.

2242 **A transistorized carrier frequency computing amplifier.** A. Solbakken, *Ann. Assn. Int. Calcul Analogique,* **3,** July 1961, 124-131. This paper describes and discusses the design of an all transistorised carrier frequency summing amplifier with a dynamic computing accuracy of 0.05 per cent. The amplifier has five independent inputs and is designed to drive three different types of load: resistive, inductive and winding compensated resolvers. Special precautions are taken to reduce gain variations due to different transistor parameters. 7 refs.

2243 **A tunnel diode function generator.** P. Spiegel, *1961 IRE Int. Convention Record,* Part 2, 164-174. This paper describes a new technique for generating functions of a single dependent variable at high speeds using tunnel diodes. Unlike a network of voltage-biased diodes which switch from non-conduction to conduction and approximate a curve with linear segments, the tunnel diode function generator requires no bias and approximates a curve by means of step functions. The step functions are initiated by the analogue threshold switching action of a simple tunnel diode circuit. This basic circuit lends itself to economical, microminiature fabrication. The tunnel diode function generator is most conveniently operated with pulse inputs and should therefore be most useful in sampled data control systems. The paper includes a description of a square root generator employing 16 germanium tunnel diodes. Its accuracy over a 1.5 to 10.0 volt range of input pulses is better than 5 per cent. 3 refs.

2244 **Cryosar memory design.** R. C. Johnston, M.I.T., *AD-257183,* 19 May 1961, 26 p., $2.60. The compensated cryosar is a negative-resistance two-terminal device utilising a bulk effect in germanium at liquid helium temperatures. Its use in a computer memory is foreseen because of its bistable nature and its ease of fabrication in large arrays. However, careful consideration of device and circuit parameters is necessary if a successful large memory is to be achieved.

2245 **Flux switching mechanisms in ferrite cores and their dependence on core geometry.** G. W. Reimherr, Nat. Bureau of Standards, *PB 161591,* May 1961, 49 p., $1.25. Plots of reciprocal switching time against applied magnetic field for ferrimagnetic or ferromagnetic cores usually show two or three interconnecting straight line segments. Different theoretical flux reversal mechanisms have been proposed for each segment. Descriptive models of these mechanisms are presented. Switching curves are shown for seven ferrite cores of different composition, and for a ferromagnetic tape core. The inverse slope of the switching curve known as the switching coefficient, was calculated for these cores and it is shown to agree well with values given by other experiments and by theory. Experiments were made to ascertain whether the flux reversal mechanisms are affected by core geometry. Nine ferrite cores were separated into four groups. The cores of each group had identical chemical composition and originally had nearly equal cross sections and identical switching curves. The cores of each group were then ground into different cross sections, at least one being rectangular and the other being square or circular, and switching curves were again taken of these cores. No effect of geometry upon the flux reversal mechanisms was found. Several factors which may effect the switching coefficient are given. 14 refs.

2246 **Proposal for magnetic domain-wall storage and logic.** D. O. Smith, M.I.T., *AD-257771,* 31 May 1961, 15 p., $1.60.

2247 **Research in ferromagnetics with applications to new storage devices.** H. W. Fuller and D. L. Sullivan, Laboratory for Electronics, *AD-249835 (PB 154240),* Sept. 1960, 147 p., $11.00. Methods of experimentally studying the interaction between magnetic domain walls in adjacent thin films are listed and described. A calculation is made for the interaction energy between two walls in adjacent films using a simplified model for a domain wall consisting of a linear dipole. A calculation of the interaction between one symmetrical and one asymmetrical wall is made and two important special cases are considered. The force function $h'f(u)$ describing the equilibrium positions of magneto-statically interacting domain walls is calculated and plotted for various cases of unequal wall widths and adjacent film separations. Some aspects of a technique for measuring the external fields of walls in thin films using powder patterns are discussed in light of Kittel's calculation concerning particle collection. Observations of particle collection on walls in a film overcoated with a non-magnetic layer are described. The principle of a wall-stepping device is described that may yield a new class of two-film storage devices. The magnetostatic interaction between a wall in one film and a parallel line imperfection in an adjacent film is considered. The magnetisation distribution for striking spiral-wall configurations is deduced and an hypothesis is advanced for the mechanism of their formation. 33 refs.

2248 **Research on opto-electronic computer components.** H. O. Hook and E. C. Giaimo, David Sarnoff Research Center, *AD-253543 (PB 155537),* 30 Nov. 1960, 66 p., $6.60. Opto-electronic digital circuits using electroluminor and photoconductor components have, with present materials, minimum switching times of approximately 50 milliseconds. Although per-element powers are about 10^{-5} watt the low speed prohibits the practical use of opto-electronic circuits in arithmetic circuits. In input, output and image processing, however, the advantages of parallel processing using neighbourhood interaction, threshold logic and negation seem to more than overcome the relative slowness of each cell. Line thinning and thickening, hole fill-in, outlining or fimbriation, motion detection, intersection detection, and negation were demonstrated, and denoising, speck removal, and character simplification seem feasible. Special photoconductor cells may provide an input to a high speed non-scanning character reader. 33 refs.

2249 **Unipolar control devices.** J. T. Wallmark, David Sarnoff Research Center, *AD-249673 (PB 154247),* 31 Oct. 1960, 12 p., $1.60. Experience with fabrication of particular integrated circuits led to important conclusions about multi-element structures in general and therefore applicable not only to semiconductor devices but also to cryogenic, magnetic, field emission, etc., devices. These design considerations were then used to guide the selection of a suitable approach to integrated electronics. The system of direct-coupled unipolar transistor logic was chosen as most in line with these considerations. It was found that all the logic circuits in a computer could be constructed in integrated form using this system. A typical example illustrating the principle and at the same time providing a very attractive practical application is an integrated binary adder. 8 refs.

2250 **Ring counter.** Automatic Telephone & Electric Co., Ltd., *B.P. 874842,* 10 Aug. 1961. This patent describes a circuit designed for improved reliability for a ring-counter employing bistable transistor circuits.

2251 **Matrix for data storage.** Int. Computers & Tabulators Ltd., *B.P. 875276,* 16 Aug. 1961. Improved arrangements are described for effecting the temporary storage and re-insertion of data read out from a matrix of magnetic cores or other elements.

2252 **Magnetic core matrix with fixed data storage.** Mullard Ltd., *B.P. 875388,* 16 Aug. 1961. A selected pattern of fixed information is stored in a magnetic core matrix by saturating with discrete fields of permanent magnets, those cores selected to be inoperative in accordance with the pattern of fixed information.

2253 **Serial adder.** Sperry Rand Corp., *U.S.P. 2987252,* 6 June 1961. A full adder for performing serial binary addition employs magnetic amplifiers interconnected to form half adders which in turn are interconnected by further magnetic amplifiers.

2254 **Analogue multiplier.** Gen. Precision Inc., *U.S.P. 2987255,* 6 June 1961. An analogue multiplier for providing an output potential proportional to the product of two independent time variables, includes two velocity servomechanisms, two potentiometers and an electronic integrator.

2255 **Parametron binary subtractor-adder.** Kokusai Denshin Denwa K.K., *U.S.P. 2988277,* 13 June 1961. A simple borrow circuit is described for a binary subtractor-adder employing parametrically excited resonators.

2256 **Cryotron adder.** R. K. Richards, *U.S.P. 2988278,* 13 June 1961. An adder circuit is described which is designed so as to minimise the number of cryotrons employed.

2257 **Magnetic core device.** Gen. Electric Co., *U.S.P. 2988649,* 13 June 1961. This patent describes a magnetic core device which is the analogue of an electrical relay circuit and can be employed in various combinations to perform complex binary logical operations. The device comprises a continuous magnetic core structure in the form of three flux paths or legs and is composed of material that exhibits remanence and has a low permeability at saturation.

2258 **Bistable transistor circuit.** Int. Business Machines Corp., *U.S.P. 2988652,* 13 June 1961. This patent describes a six-terminal transistor which acts as two independent transistors, and its use in a bistable circuit.

2259 **Cathode ray storage tube.** Burroughs Corp., *U.S.P. 2988668,* 13 June 1961. This patent describes a cathode ray tube having two electron guns and a storage plate composed of magnetic material with rows and columns of perforations.

2260 **Wound tape magnetic core.** Minneapolis-Honeywell Regulator Co., *U.S.P. 2988674,* 13 June 1961. A magnetic core is formed by winding magnetic tape on a non-magnetic metal bobbin provided with a protective sleeve.

2261 **Shift register.** Int. Business Machines Corp., *U.S.P. 2988701,* 13 June 1961. This patent is concerned with the design of a shift register operable at high speed in either direction and in which a gate is provided at the entry to each trigger of the register, the gate including a comparison circuit for checking the condition of that trigger with that of the preceding trigger. Electron tube and transistor circuits are described in detail.

2262 **Magnetic data storage device.** Bell Telephone Labs., Inc., *U.S.P. 2988733,* 13 June 1961. This patent describes a device, suitable for use in a storage matrix, comprising a magnetic conductor having bistable state remanence characteristics in a preferred helical flux path, which is helically wound about an elongated non-magnetic conductor.

2263 **Magnetic core counting circuit.** Bell Telephone Labs., Inc., *U.S.P. 2989647,* 20 June 1961. This patent describes a magnetic counting circuit in which activating current is applied simultaneously to activating windings by means of a common winding threading all cores.

2264 **Cryotrons.** Int. Business Machines Corp., *U.S.P. 2989716,* 20 June 1961. A method is described for manufacturing a thin film superconductive device having relatively abrupt magnetic and temperature transitions between superconducting and normal resistance states.

2265 **Binary comparator.** Burroughs Corp., *U.S.P. 2989734,* 20 June 1961. Circuitry for comparing two binary expressions which employs bistable ferroelectric or ferromagnetic elements is described.

2266 **Parallel adder for binary-decimal.** Nat. Cash Register Co., *U.S.P. 2991009,* 4 July 1961. This patent describes an adder which adds binary signals representing decimal digits in parallel fashion and comprises two simultaneously operating adder units. One unit responds to the coded decimal digits in the binary number system; the other unit responds to one digit in the binary number system and to the other digit as converted to the binary 'excess 6' number system.

2267 **Magnetic core device.** Int. Business Machines Corp., *U.S.P. 2991455,* 4 July 1961. A multipath magnetic core device for performing logical functions.

2268 **Reversible shift register.** Laboratory for Electronics Inc., *U.S.P. 2991456,* 4 July 1961. A shift register employs magnetic amplifiers and two sets of gates for providing data transfer in either direction.

2269 **Binary adder.** Bell Telephone Labs., Inc., *U.S.P. 2992339,* 11 July 1961. A simple circuit for adding a pair of single digit binary numbers, includes a four-terminal bridge with a diode in each arm.

2270 **Counter circuit.** Burroughs Corp., *U.S.P. 2992393,* 11 July 1961. This patent is concerned with the design of a counter circuit employing a multi-stable magnetic core, to improve the signal to noise ratio.

2271 **Magnetic core pulse circuit.** Int. Business Machines Corp., *U.S.P. 2992415,* 11 July 1961. A pulse delay circuit employing a multipath magnetic core is described.

2272 **Magnetic core device.** Hughes Aircraft Co., *U.S.P. 2993197,* 18 July 1961. This patent describes a multipath magnetic core device and its use in shift register, gating, flip-flop and other circuits.

See also :—
General, Ref. 2112.
Design, Refs. 2129 and 2134.
Applications, Electronics, Ref. 2306.

ANALOGUE

2273 **A simulator for the evaluation of electromagnetic systems.** L. G. Fischer and G. Frenkel, *1961 IRE Int. Convention Record,* Part 2, 135-142. An account is given of the Electronic Defense Evaluator (EDDY), an analogue simulator developed by ITT Federal Laboratories for the evaluation of electronic warfare equipment. Its major parts include three target coordinate generators, modules for simulation of search and tracking radars, communication systems, electronic counter measures, anti-jamming elements and a comprehensive data and display group. An analysis of the system is given, indicating how the radar equation is accurately synthesised through use of i.f. modulators with logarithmic characteristics, whereby simple summation results in the product of all the variables, as required by the basic equation. A discussion of EDDY connected in the monopulse mode, is presented, indicating the necessary conditions which bound the problem and lead to the configuration shown.

See also :—
Applications, Simulation, Ref. 2355*d*.

DIGITAL

2274 **Four computers compared.** R. M. Paine, *Auto. Data Processing,* **3,** Aug. 1961, 32-34. The features and capabilities for business applications of four new, medium-sized transistorised digital computers are compared. The computers are: Honeywell 400, ICT 1301, IBM 1410 and NCR 315.

2275 **KDF 9.** *Data Processing (London),* **3,** July-Sept. 1961, 176-181. A general account of the main features of the English Electric KDF 9 digital computer.

2276 **A simple experimental computer with negative basis.** A. Lazarkiewicz and W. Balasinski, *Maths. of Computation,* **15,** July 1961, 275-285. This paper describes the organisation of a simple experimental computer operating in the minus-two system, which is being tested at Warsaw Technical University. The principles for composing the instructions from elementary operations, the characteristics of minus-two computer arithmetic, and the logic of the arithmetic unit are briefly explained. The computer is a small general purpose machine for scientific and technical calculations which works at a speed of about 100 operations per second. It makes use of the serial mode of operation and is a single-address, fixed-point machine with a magnetic drum as the only memory. 6 refs.

PROGRAMMING

2277 **Address translation.** G. A. Blaauw and C. B. Poland, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 40-42. Five-byte addresses in a computer instruction are each treated as a blank byte, a symbolic block address byte, high order word address byte, low order word address byte, and byte address byte. During address translation, the symbolic block address byte is converted to a two-byte actual block address. The actual block address replaces both the blank byte and the symbolic block address byte.

2278 **An algorithm for equivalence declarations.** B. W. Arden, B. A. Galler and R. M. Graham, *Commun. ACM,* **4,** July 1961, 310-314. This paper is concerned with the allocation of storage assignments in algebraic translators, when it is desired to make certain vectors and arrays contiguous, coincident or overlapping. This can be done with the aid of EQUIVALENCE declarations. An algorithm is described, with the aid of an example, which results in a storage assignment for each variable and array occurring in any EQUIVALENCE statement.

2279 **COBOL-grammatiken.** (COBOL-grammar) K. Volby, *BIT,* **1,** No. 3, 1961, 206-219. (In Swedish) The second article of a series of three on COBOL (for first article see *C.A.,* **5,** June 1961, Ref. 1261). In this article the grammar rules are discussed and the structure of a COBOL program is described in detail.

2280 **Correspondence.** J. M. Watt; R. A. Brooker and D. Morris, *Computer J.,* **4,** July 1961, 167, 176. Letter commenting on the papers by R. A. Brooker and D. Morris, 'An assembly program for a phrase structure language', *ibid,* **3,** Oct. 1960, 168-174 (*C.A.,* **4,** Dec. 1960, Ref. 2448) and 'Some proposals for the realization of a certain assembly program', *ibid,* **3,** Jan. 1961, 220-231 (*C.A.,* **5,** March 1961, Ref. 578), together with the authors' reply.

2281 **Criticisms of ALGOL 60.** B. W. Arden, B. A. Galler and R. M. Graham, *Commun. ACM,* **4,** July 1961, 309. Letter criticising ALGOL on the basis that it does not include as much of conventional notation as possible.

2282 **Indirect addressing arrangement.** F. B. Jones, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 49-51. Description of arrangements operable by indirect address instructions.

2283 **An input system for electronic computers.** J. V. Garwick, *BIT,* **1,** No. 3, 1961, 177-199. The author suggests that an input program should be as comprehensive as possible and uses the term 'input system' as having a wider meaning than 'input program' in its usual sense. An input system includes all communications with the machine when single machine orders can be distinguished and even in other cases. An account is given of such an input system, primarily for a machine with magnetic tape and simultaneous programming but which is generally applicable.

2284 **Precision mode bit.** G. B. Hedrick, W. V. Wright and G. A. Blaauw, *IBM Technical Disclosure Bull.,* **4,** Aug. 1961, 43-45. Computers designed for scientific computation may use more than one floating point operand. In particular, single-precision (half-word) and double-precision (full-word) formats may be employed. A description is given of the use of a precision mode bit in the program control word to specify choice of format. Changes between single and double precision modes can involve elaborate programs which anticipate all possible means of address computation. The function of the precision mode bit and its allied circuitry is to allow a program written in double precision mode to be used directly for single precision processing, without interference from address modification in its relationship with half-word processing.

2285 **Sequencing aspects of multiprogramming.** J. Heller, *J. Assn. Computing Mchy.*, **8,** July 1961, 426-439. This paper is concerned with the sequencing or scheduling aspects of multiprogramming. These aspects revolve around questions of parts of a computer being idle because data to be processed in one computer part is still being processed elsewhere in the computer; and, in the case of a group of independent programs, the staggering of the parts of the programs through the computer so that some defined objective of all the programs is optimised. The aim of the paper is to formulate the problems of multiprogramming scheduling. The discussion proceeds by means of simple examples in simple steps. Flow diagrams are considered first, then schedule diagrams which describe the technological ordering of the program, and, finally, Gantt or timing diagrams which describe the actual times to finish a particular subprogram. The one program case is examined first and then the scheduling of many programs. 7 refs.

2286 **Vary operation.** G. A. Blaauw, *IBM Technical Disclosure Bull.*, **4,** Aug. 1961, 46-48. In certain variable field-length data processors, it is expedient to deal with bits, bytes and fields as basic information units. A byte is normally a group of four bits and a field is a variable number of bytes not greater than the number of bytes in a word but which may cross word boundaries. Certain processing applications require address modification by a word increment and a byte increment. A description is given of the performance of this address modification by a four-step subprogram similar to serial addition.

2287 **The Noval Ordnance Research Calculator (NORC) Compiler.** K. Kozarsky, Naval Weapons Lab., *AD-62333 (PB 156346),* 17 May 1955 (Released to public 28 June 1961), 35 p., $3.60. This report describes the current status of the Naval Ordnance Research Calculator (NORC) Compiler. This routine is an automatic coding technique designed to minimise the time spent on the coding of problems for solution on NORC. The computer converts unordered symbolic or relative codes to ordered machine (absolute) codes, generates and assembles subroutines from a library file, provides a variety of other services for the coder, and writes the final coding on tape, ready to be run on NORC. Use of the compiler enables a considerable amount of tedious coding time to be saved. The time required to compile a program is usually two minutes or less of NORC machine time. 9 refs.

See also :—
Applications, Physics, Ref. 2349.

APPLICATIONS

AERO- AND ASTRONAUTICAL

2288 **The analysis of fuselages of arbitrary cross-section and taper.** J. H. Argyris and S. Kelsey, *Aircraft Engng.*, **33,** Feb. 1961, 34-45; March 1961, 71-83; April 1961, 103-113; June 1961, 164-174; July 1961, 193-200; Aug. 1961, 227-238. Continuation of the account of a D.S.I.R. sponsored research programme on the development and application of the matrix force method and the digital computer. For earlier parts see *ibid,* **31,** 1959, 62-74, 101-112, 133-143, 169-180, 192-203, 244-256 and 272-283 (*C.B.*, **3,** 1959, Refs. 1322, 1611, 2046, and 2203).

2289 **Real-time analog-digital computation.** M. E. Connelly, *1961 IRE Int. Convention Record,* Part 2, 182-195. This paper is concerned with research on the use of analogue-digital computers for operational flight trainers. After discussing the relative advantages of analogue and digital techniques in simulating complex, nonlinear systems in real time, a hybrid configuration is suggested that employs peripheral, high speed analogue elements used on a time-shared basis under the control of the digital program. Programs for function generation and for the aircraft roll equation are presented to illustrate the functioning of a hypothetical analogue-digital computer. 14 refs. (See also Ref. 2293.)

2290 **Analytical evaluation of a method of midcourse guidance for rendezvous with earth satellites.** J. M. Eggleston and R. S. Dunning, NASA, *AD-257801,* June 1961, 61 p., $1.75. A digital computer simulation was made of the midcourse (or ascent) phase of a rendezvous between a ferry vehicle and a space station. The simulation involved a closed-loop guidance system in which both the relative position and relative velocity between ferry and station are measured (by simulated radar) and the relative-velocity corrections required to null the miss distance computed and applied. The results are used to study the effectiveness of the guidance and errors in launch conditions and errors in the navigation (radar) data. Trajectories are presented for rendezvous with a space station in a circular orbit and in an elliptic orbit.

2291 **Evaluation of Visual Distance Computer CP-384/GMQ (XD-1).** P. I. Hershberg, Air Force Cambridge Research Labs., *AD-250585 (PB 154896),* April 1960, 36 p., $3,60. The Visual Distance Computer was designed to automatically provide accurate information regarding range and height at which a pilot can expect to see runway approach lights. A list of the tests performed during the evaluation of the Computer is given, including test results and recommendations. The equipment is accurate and reliable and, when recommended modifications are completed, the Computer should be suitable for field use. Also presented and discussed are basic equations used in solving visual distance problems, initial approximations to existing conditions for each equation solution, and revised equations together with a need for a computer solution of these equations. Two appendices discuss the computer design and details of the evaluation testing program. 6 refs.

2292 **Notes on analytical techniques in aerodynamic heating problems.** Naval Ordnance Test Station, *AD-258223,* 28 April 1961, 34 p., $3.60. This report consists of the following :

a. **Temperature changes during heating of an HPAG 5.0-inch motor: correlation of experimental data with analog computations.** C. H. Johnson. Temperature data on a 5.0-inch HPAG rocket motor served to guide the set up of an analogue computer model.

b. **Determination of wall temperature-time functions using an analog computer.** W. H. Smith. The use of an analogue computer to obtain solutions of the outside surface temperature of aerodynamically heated bodies resulted in a large saving over hand solutions.

c. **When is a skin thermally thin.** J. R. Katz. A method for determining skin thickness is discussed for 1, 5 and 10% variations in temperature throughout the material.

2293 **Real-time analog-digital computation.** M. E. Connelly, M.I.T., *AD-257987,* April 1961, 19 p., $2.60. Reprint of the paper appearing in *1961 IRE Int. Convention Record,* Part 2, 182-195. (See Ref. 2289)

2294 **Simulation and evaluation of a proposed analytic flight path computer.** P. Gevas and W. L. Harmon, Wright-Patterson Air Force Base, *AD-142229 (PB 156112),* Dec. 1957 (Released to public 14 June 1961), 40 p., $3.60. This report is concerned with the simulation and testing of a proposed analytic flight path computer designed to guide an aircraft to a fixed point and arriving at a given time with a specified ground track The resulting flight paths for various initial and final conditions are evaluated. The continuously computed desired-heading angle necessary to satisfy the initial conditions and final boundary conditions is obtained from an analytic solution, which includes a linear interpolation approximation, and is one of several optimum solutions in terms of the resulting flight paths and ease of instrumentation. The analytic solution is successfully approximated with a diode function generator. The solution generates flight paths which successfully solve the guidance problem. The analytic computer is compared to the elastic spring computer designed to solve the same problem. The coefficient of the linear interpolation approximation is found to be critical for large angles of approach. Recommendations are made which point to further investigations of the analytic solution. 4 refs.

See also :—
Electronics, Ref. 2311.
Engineering, Mechanical, Ref. 2330.
Military, Ref. 2343.
Simulation, Ref. 2355*b*.

BUSINESS

2295 **Character recognition and document handling in banks.** R. Hindle, *Computer J.*, **4,** July 1961, 157-159, disc. 159-160. Systems for sorting documents and for character recognition are briefly reviewed with reference to the special requirements of banks.

2296 **The computer manufacturer's role in management games.** B. Nanus, *Data Processing (Detroit),* **3,** Aug. 1961, 19-20. This article discusses reasons for using computers in management games, reasons why manufacturers should explore this field and the services they can offer.

2297 **Correspondence.** Z. Herzenstein and F. E. A. Briggs; A. Young and G. Almond, *Computer J.*, **4,** July 1961, 128. Letter commenting on 'Predicting distributions of staff', A. Young and G. Almond, *ibid*, **3,** Jan. 1961, 246-250 (*C.A.*, **5,** March 1961, Ref. 584) together with the authors' reply. 7 refs.

2298 **A Direct Ordering, Recording and Invoicing System.** G. Jennings, *Computer J.*, **4,** July 1961, 150-152, disc. 152-156. A general account of DORIS (Direct Order Recording and Invoicing System), electromechanical equipment installed at the Royston Depot of Shell-Mex and B.P. An operator depresses push buttons in accordance with the details of an order taken on the telephone and the equipment produces sales tickets and invoices.

2299 **Four years later.** *Auto. Data Processing,* **3,** Aug. 1961, 26-29. An account of the use made of a National-Elliott 405 system by Norwich Council during the past four years and of plans for future developments with a larger 405 system shortly to be installed.

2300 **Probleme der Lagerdisposition.** (Problems of stock management.) P. Lindemann, *Elektronische Datenverarbeitung,* No. 3, 1961, 106-110. (In German) This paper discusses the difficulties of optimum planning and scheduling in stock-keeping. The possibilities offered by electronic data processing are then outlined, and various solutions as to organisation and equipment are discussed, with particular reference to stock-keeping problems in the chemical industry.

2301 **A simple, inexpensive sales analysis procedure.** *Data Processing (London),* **3,** July-Sept. 1961, 190-193. An account is given of the system used by A. W. Gamage Limited to analyse mail order sales. Information of mail order sales is recorded on paper tape by two Sweda cash accounting machines equipped with 5-channel tape punches. Once a week, the punched tapes are forwarded to the Ferranti computer service centre where the data is analysed on a PEGASUS and the relevant sales statistics produced. In effect, the PEGASUS is employed as an extremely fast multi-register adding machine with the advantage that it also performs certain data checking operations automatically.

2302 **We lost $25,000.** V. B. Thompson, *Data Processing (Detroit),* **3,** Aug. 1961, 15-16. Brief account by a participant of the sales management game, Marketing Management Simulation, which employs a UNIVAC 80.

2303 **Why management games?** F. M. Webster, *Data Processing (Detroit),* **3,** Aug. 1961, 9-13. After a brief explanation of management games (with and without use of a computer) and a review of their development, reasons why a busy executive should be interested in such games are presented.

CHEMICAL

2304 **Simulation of a recirculating, stirred chemical dissolver on an analog computer.** G. R. Taylor, Hanford Atomic Products Operation, *HW-62902,* March 1961, 32 p., $0.75.

CONTROL—GENERAL SYSTEMS

2305 **Manned simulation research in complex control systems.** M. A. Geisler and W. A. Steger, *Commun. ACM,* **4,** July 1961, 323. Brief account of the use of manned simulation at the Rand Logistics Systems Laboratory to aid in the design of control systems. 3 refs.

ELECTRONICS

2306 **Large-signal circuit theory for negative-resistance diodes, in particular tunnel diodes.** M. Schuller and W. W. Gärtner, *Proc. IRE,* **49,** Aug. 1961, 1268-1278. This paper describes the quantitative analysis, without any of the customary simplifications, of the large-signal high frequency applications of a tunnel diode as an oscillator and as a monostable and bistable switch by solving on a digital computer the system of nonlinear differential equations which describe the diode and the external circuitry. Frequency, amplitude, distortion and switching times are calculated with high accuracy as functions of operating point and circuit inductance. The approach is general and can be applied to any nonlinear electronic device. 6 refs.

2307 **Wiring terminal panels by machine.** R. K. Grim and D. P. Brouwer, *Control Engng.,* **8,** Aug. 1961, 77-81. Account of the use of a computer and a wiring machine to facilitate the design and production of a complex wiring panel, e.g. for a computer. The computer produces from logic diagrams, a punched card output which is used to control a Gardner-Denver wire wrapping machine.

2308 **Capacitor bank parameters.** G. Brucker, Stevens Inst. of Tech., *AD-258331,* 1 April 1961, 10 p., $1.10. This report is concerned with experiments carried out with the Stevens capacitor bank and the Megatron Coil Mk. I as the load, the crowbarring technique being successfully applied to the bank with the G.E. ignitron No. 5385. A Datatron 220 was used to solve equations expressing the bank voltage for a circuit of 2 transmission lines with a total of 12 capacitors. Results of the calculations are given for three cases: (1) 4 pairs of lines, a total of 48 capacitors with the load varying from zero to 100 millimicrohenries; (2) 6 pairs of lines, a total of 72 capacitors, with the load from zero to 100 millimicrohenries; (3) a load of zero and the bank shorted at the cables.

2309 **Cross sections and polarization ratios of dipole clouds.** B. M. Brown, University of Texas, *AD-257624,* 15 Sept. 1960, 1 v., $16.00. Measurements indicate that clouds of falling dipoles are either predominantly vertical or predominantly horizontal. A program for computing responses from horizontal and vertical dipoles by means of an IBM 650 has been written and some results are presented. The program provides the cross section of a vertical dipole to vertically polarized radars; the average cross section of a horizontal dipole to vertically polarized radars; and the average cross section of a horizontal dipole to horizontally polarized radars. A program was written for computing the ratio of the vertical radar response to the horizontal radar response from a dipole cloud in which a fraction of the dipoles are vertical, the remainder being horizontal.

2310 **Design of lossy filters by digital computer.** S. K. Mitra and C. A. Desoer, University of California, *AD-253175 (PB 155360),* 22 Dec. 1960, 42 p., $4.60. Non-availability of ideal or dissipationless elements is a major drawback in the development of filters having some prescribed magnitude characteristic. In this paper, a simple and straight-forward design procedure using a high-speed digital computer as the main tool is presented, for designing lossy filters built with lossy elements having unequal dissipation factors with no restriction on the amount of losses of the elements. The main idea is to perturb the elements so that the difference between the magnitude characteristics of the ideal filter and the corresponding lossy one at some discrete frequencies is minimised in the least-squares sense. The mathematical basis is first presented and then the results of using the suggested method in designing a lossy Chebyshev filter are discussed. 12 refs.

2311 **Determination of ionosphere parameters by means of a satellite antenna-type probe: II. Analysis for spherical geometry.** W. W. Zachary, Electromagnetic Research Corp., *AD-251231 (PB 154779),* 31 Dec. 1960, 43 p., $4.60. The analysis of a spherical antenna-type ionosphere probe is given. The change in input admittance upon immersion of the antenna in a magneto-ionic medium is evaluated by expressing the field as the sum of the free-space field and a secondary field. The secondary field is evaluated by successive approximations. Calculations are carried through in detail for the first approximaton. Higher order approximations can be evaluated by the same procedure. The analysis is in a form which lends itself to numerical evaluation on a digital computer. 12 refs.

2312 **The use of digital computers in speech analysis and synthesis.** C. P. Smith, Air Force Cambridge Research Center, *AD-257527,* Nov. 1959, 6 p., $1.10. A new approach toward the goal of compressed digital speech communication is based on speech data reduction in successive stages. First, the voice signal is measured in a Vocoder type of analyser and the input information digitised. The spectrum pattern data is then reduced by selecting the best approximations from a stored set of spectrum patterns, and reading out the pattern serial numbers. This data is further reduced by selection of the best approximations from a stored set of pattern sequences and pitch sequences. The serial numbers of the sequences are transmitted. At the receiver, an inverse process expands the information to a voice output.

See also :—
Analogue, Ref. 2273.
Simulation, Ref. 2355*a*.

ENGINEERING, ELECTRICAL

2313 **Auxiliary-winding design for split-phase motors.** L. W. Buchanan and N. Maupin, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1183-1187, disc. 1187-1188. This paper develops a procedure, easily programmed for a digital computer, for design of an auxiliary winding of a split-phase motor after the main and auxiliary winding distribution is selected. 3 refs.

2314 **Berechnung der Lastverteilung in Energieversorgungsnetzen mit Digitalrechnern.** (Computation of load distribution in power supply networks with digital computers.) S. Arkéus and J. A. Bubenko, *Elektronische Datenverarbeitung,* No. 3, 1961, 123-130. (In German) This paper presents the nodal iterative method for load distribution computation. The program was developed for the Swedish computer FACIT EDB which at present has 2,000 words of core memory and 8,000 words of drum memory. The data input is in nodal form. The program permits a network of up to 199 nodes, about 600 lines and 25 transformers. The number of transformers can be increased for a system of smaller size. At each node a generator, synchronous capacitor, load, reactor and/or capacitor can be interconnected. The computer time is 0.3 to 0.4 seconds per node and iteration. The output data comprises voltages and powers at all nodes and line loadings and losses. 6 refs.

2315 **Calculation of steady-state and transient ratings of electric wire.** R. W. Stineman and G. W. McIntyre, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1157-1165. A method is described of calculating current ratings for wire, employing basic-material properties and based on well-known principles of heat transfer, electric phenomena and mathematics. An IBM 704 program is described in some detail. The computer output consists of printed tables of continuous current capacities and allowable times for various overload currents, both for wires installed singly and in bundles with specified total bundle currents. An account is given of laboratory tests undertaken to ascertain that the computer results are of the desired accuracy. 6 refs.

2316 **Computer design of capacitor-start-motor start windings.** A. E. Hartman and G. V. Mueller, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1087-1090. With certain approximations the starting conditions in a capacitor-start motor can be represented by circle diagrams which are of assistance in the writing of computer programs. This paper shows the application of such diagrams to determine the size and the voltage rating of the capacitor to be used with a given start winding, or to the design of a start winding to develop a specified starting torque with a given capacitor. 3 refs.

2317 **Digital calculation of 3-phase short circuits by matrix method.** H. E. Brown, C. E. Person, L. K. Kirchmayer and G. W. Stagg, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1277-1281, disc. 1281-1282. This paper describes a new matrix method and an IBM 704 program for 3-phase short-circuit calculations. 10 refs.

2318 **Digital calculation of sequence impedances and fault currents for radial primary distribution circuits.** R. C. Ender, G. G. Auer and R. A. Wylie, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1264-1275, disc. 1275-1277. An account is given of two IBM 704 programs: one for calculating the positive and zero sequence impedances of overhead primary circuits, using conductor size, conductor material and line geometry data; the other for calculating maximum and minimum values of fault currents at specified points on a radial primary circuit using line impedance data from the first program together with voltage, source impedance, and fault impedance data. 6 refs.

2319 **Digital computer study of the resynchronizing of a turboalternator.** R. N. Sudan, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1120-1129. This paper describes a detailed study on an IBM 650 of a single turboalternator connected through a transmission line to a system large enough to be considered infinite. 16 refs

2320 **Digital programs for calculation of transmission line impedances.** N. Savage, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1229-1235. This paper describes, with flow diagrams, IBM 650 programs which calculate the series impedances and shunt reactive power of 3-phase, 60 c/s, open-wire, power transmission lines. The application of the programs is limited as follows: lines are fully transposed; towers carry no more than 2 circuits; each circuit has only one conductor per phase; each tower has no, one or two identical ground wires; ground and ground wires are ignored in positive-sequence quantities calculation; height above ground is ignored. Output is: (1) zero-sequence impedance per phase; (2) positive-sequence impedance per phase; (3) total 3-phase positive-sequence charging kva at 120 kv; (4) zero-sequence mutual impedance between two circuits on one tower. 6 refs.

2321 **Digital techniques in commutation design.** H. K. Kesavan and H. E. Koenig, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1054-1058. This paper describes a program (for an unspecified digital computer) for commutator machine design, based on theory given in Ref. 2326. 2 refs.

2322 **A digital transient stability program including the effects of regulator, exciter, and governor response.** M. S. Dyrkacz, C. C. Young and F. J. Maginniss, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1245-1254, disc. 1254-1257. This paper gives an account of modifications made in a General Electric Company's program for calculating the transient stability characteristics of power systems. The changes are concerned with transient saliency; representation of capacitors; provision for 96 generators; load characteristics; voltage regulator and exciter action; and speed governor action. An evaluation and check-out of the program for a particular system is also discussed. 5 refs.

2323 **Economic dispatch of generation directly from power system voltages and admittances.** R. B. Squires, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1235-1244, disc. 1244-1245. In a power system having several turbine-generators whose combined capacity exceeds the load, there is only one combination of generator loadings which minimises the total fuel input to the turbines. This paper presents a new method of determining such economic dispatch of power, outlines a computer program and discusses some numerical results. 22 refs.

2324 **The effect of unit size, reliability, and system service quality in planning generation expansion.** C. J. Baldwin, C. A. DeSalvo and H. D. Limmer, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1042-1048, disc. 1048-1050. This paper is concerned with the use of digital computer simulation to permit rapid detailed economic studies of power system expansion problems. Results are discussed for studies of the economic effect of ultimate unit size, boiler arrangement, forced-outage failure rate and system service quality standard. 10 refs.

2325 **Hydrothermal economic scheduling—computational experience with co-ordination equations.** P. L. Dandeno, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1219-1228, disc. 1228. An account is given of the experience of the Hydro-Electric Power Commission of Ontario, Canada, in using the IBM 650 for obtaining solutions of the hydrothermal coordination equations. These equations describe the manner in which hydro and thermal stations should be scheduled over a given period where (1) the load demand is known, (2) the total and incremental losses can be calculated, (3) the hydro stations use the prescribed amount of water available and no more, and (4) the fuel consumption of the thermal stations is a minimum. Computer techniques are described and calculated schedules are compared with actual schedules. 3 refs.

2326 **A new criterion for satisfactory commutation.** H. K. Kesavan and H. E. Koenig, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1058-1066. This paper presents a mathematical study of two aspects of the commutation problem: the inherent characteristics of the armature winding as they affect commutation; and the effect of the coupling between the fields and the armature circuits. On the basis of this study, a new criterion for the choice of the armature winding for satisfactory commutation is developed. Mathematical procedures for relating this criterion, called the commutation factor, to the details of machine design are presented, and a program based on these procedures is given in Ref. 2321. 12 refs.

2327 **New digital computer short-circuit program for relay studies.** G. E. Taylor, G. K. Carter and E. H. MacDonald, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1257-1264. This paper describes and discusses an IBM 704 program which uses load-flow data of a system and performs fault calculations to assist in the application of protective relays to power systems. 8 refs.

2328 **Practical applications of digital computers to distribution systems.** T. L. Hatcher and E. L. Busby, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1290-1299, disc. 1299-1300. Three IBM 650 programs applicable to distribution problems are described. The programs are: (1) series bus load flow; (2) radial short-circuit current calculation; and (3) load power-factor calculation and correction. 1 ref.

2329 **Reclosing transients in induction motors with terminal capacitors.** F. P. de Mello and G. W. Walsh, *Power Apparatus & Systems,* No. 52, Feb. 1961, 1206-1213. This paper presents an analogue computer method for the determination of reclosing transients in the capacitor-excited induction motor. One series of computer runs provides motor residual flux and voltage as a function of time after switching motor off for various capacitor sizes and rates of change of slip; another series provides transient electrical torque following reclosure. 11 refs.

See also :—
Mathematics, Ref. 2175.

ENGINEERING, MECHANICAL

2330 **Data recording and processing in aircraft-gas-turbine evaluation.** P. A. Verrette, *Instr. & Control Systems,* **34,** Aug. 1961, 1434-1437. This article is concerned with the gas turbine component test facilities of the General Electric Company's Flight Propulsion Division, with particular reference to data processing techniques used for research component compressor testing. Descriptions are given of the use made of ICPAC (Instantaneous Compressor Performance Analysis Computer), a real-data, real-time analogue computer and of an IBM 704.

2331 **PECAN: a cycle analysis code for gas turbine, nuclear or conventional power plants (IBM 704 computer).** S. Luchter, W. J. O'Donnell and W. C. Reynolds, Aerojet-General Nucleonics, *AGN-TM-391,* April 1961, 59 p., $1.25.

ENGINEERING, STRUCTURAL

2332 **Response of arches under dynamic loads.** R. T. Eppink and A. S. Veletsos, Illinois University, *AD-257572,* Aug. 1960, 148 p., $11.50. A study was made of the response of arches subjected to the influence of transient forces. A numerical procedure is presented for the computation of the dynamic response of arches for both the elastic and the inelastic ranges of deformation. The procedure is applicable to arches having any shape and any distribution of mass and stiffness. The distribution of the pressure along the arch and its timewise variation may be arbitrary. Computer programs are described for the analysis of two general classes of problems: (a) circular elastic arches subjected to a uniform normal pressure of arbitrary timewise variation; and (b) arches of arbitrary shape subjected to a triangular moving pressure pulse. For the latter case it is possible to evaluate the response in the inelastic range of behaviour. Numerical solutions are presented for a wide range of the parameters involved, and the effects of the various parameters are discussed.

See also :—
Aero- and Astronautical, Ref. 2288.

INFORMATION RETRIEVAL

2333 **Automatic indexing: an experimental inquiry.** M. E. Maron, *J. Assn. Computing Mchy.,* **8,** July 1961, 404-417. This paper discusses a statistical approach to the automatic classification (indexing) of documents according to their subject content and describes an experiment to test the value of the technique. The statistical technique involves (1) the determination of certain probability relationships between selected content-bearing (or clue) words and subject categories, and (2) the use of these relationships to predict the category to which a document containing the words belongs. The technique is based on the thesis that statistics on kind, frequency, location, order, etc., of selected words are adequate to make reasonably good predictions about the subject matter of documents containing these words.

2334 **A class of search-models for machine retrieval.** E. Wong, *Commun. ACM,* **4,** July 1961, 324. Brief account of a class of theoretical models for studying optimum search-strategies in one dimension, which have been constructed with a view towards the eventual application of the strategies to machine retrieval.

2335 **Correspondence.** C. R. Merton, *Computer J.,* **4,** July 1961, 120. Letter defending the paper 'Prime number coding for information retrieval', A. H. Cockayne and E. Hyde, *ibid,* **3,** April 1960, 21-22 (*C.A.,* **4,** June 1960, Ref. 1052), against criticisms made in a letter from R. A. Fairthorne, *ibid,* **4,** April 1961, 85 (*C.A.,* **5,** June 1961, Ref. 1309).

2336 **Baseball: an automatic question-answerer.** B. F. Green, A. K. Wolf et al, M.I.T., *AD-257778,* 1960, 6 p., $1.10. Baseball is a computer program that answers questions phrased in ordinary English about stored data. The program reads the question from punched cards. After the words and idioms are looked up in a dictionary, the phrase structure and other syntactic facts are determined for a content analysis, which lists attribute-value pairs specifying the information given and the information requested. The requested information is then extracted from the data matching the specifications, and any necessary processing is done. Finally, the answer is printed. The program's present context is baseball games; it answers such questions as 'Where did each team play on July 7?'

See also :—
Learning and Pattern Recognition, Ref. 2153.

MECHANICAL TRANSLATION

2337 **A table look-up machine for processing of natural languages.** J. L. Craft, E. H. Goldman and W. B. Strohm, *IBM J. Res. & Dev.,* **5,** July 1961, 192-203. This paper describes a table look-up language processing machine based on a dictionary held in a large, high speed, random access, photographic memory, which has been constructed and tested and used for translating Russian technical articles and newspapers into rough English. It makes use of automatic retrieval of lexical information by means of novel addressing features which allow look-up of phrases regardless of length. Linguistic determinations made on the basis of the lexical information retrieved govern subsequent operations. In addition, a sentence buffer holds a sentence long enough to make the backward and forward passes which will be required to make grammatical and contextual analyses by techniques now being developed. 11 refs.

2338 **Machine translation. A review and analysis report.** D. A. Kellogg, Army Research Office, *AD-257839,* Feb. 1961, 39 p., $0.50. A summary of the history, objectives, present status, and projected plans of the U.S. Army programme in machine translation is made. A similar review in less detail is included for all other government sponsored research in machine translation. The Army programme consists of three major efforts: machine translation of scientific literature from Russian to English; a similar programme from German to English; and the development of a print reader capable of scanning Russian journal pages to furnish input for the machine translation. Examples of results of present efforts are included.

2339 **Procedures for the determination of distributional classes.** K. E. Harper, Rand Corp., *AD-257287,* 23 Jan. 1961, 19 p., $2.60.

2340 **Syntactic analysis in automatic translation.** M. E. Sherry, Harvard University, *AD-253273 (PB 155470),* Jan. 1961, 360 p., $21.00. A method for the syntactic analysis of Russian sentences, applied to automatic translation, is divided into a morphological word-by-word phase and a syntactical sentence-by-sentence phase. An idealised canonical stem dictionary is presented, and its significant lexicographic properties are pointed out. This idealised dictionary then serves as a basis for evaluating the actual Harvard Automatic Dictionary. Aspects of morphological analysis of the Russian language and a series of programs written to carry it out are described. To explain the practical problems encountered in an experimental syntactic analysis program, of which a detailed description is given, a new model of natural language is introduced. 35 refs.

2341 **Transformational criteria for the classification of predicative genitive constructions in Russian.** D. S. Worth, Rand Corp., *AD-257288,* 24 Jan. 1961, 15 p., $1.60. A major advantage of Russian constructions containing genitive substantives that the investigator is no longer bound to the low levels of generality inherent in the morphological detail of actual sentences. Instead, he can regard syntax as a dynamic, addressor-oriented process, the units of which form a hierarchy of functional abstractions. This conception is illustrated by an analysis of Russian constructions containing genitive substances that must be modified by another unit, although the exact form (adjective or substantive) of this second unit is irrelevant. The transformationally determined varieties of such constructions are catalogued, and it is shown that all such constructions contain either an actual or an implied predication.

2342 **On the value of a dependency connection.** D. G. Hays, Rand Corp., *AD-257286,* 20 Jan. 1961, 21 p., $2.60. In sentence-structure determination, values are tentatively defined as numbers assigned to types of syntactic relations in such a way that connections of higher value are established in preference to connections of lower value. For a text in which sentence structures are known, the values of some syntactic relations can be estimated by the following plan: assign value 1 to a relation provided no relation is known to have lower value; assign value 2 to a relation provided all relations known to have lower value are also known to have value 1; etc. The same procedure can be used for assigning adjectives to order classes, and for other similar purposes.

See also :—
Books, Ref. 2364.

MEDICAL

See :—
Simulation, Ref. 2355*c*.

MILITARY

2343 **Digital computer systems studies.** T. Winkler, Space Technology Labs., Inc., *AD-257621,* 31 Dec. 1960, 103 p., $9.60. Methods are being investigated to improve the quality and reliability of missile guidance systems for WS 107A-1, WS 107A-2, WS 315A, and WS 133A. Study efforts were devoted to the following areas: (a) storage medium evaluation, (b) studies of input-output circuits, (c) design of circuit building blocks to support these efforts, and (d) studies of mechanical assembly methods. In addition to continuing work on circuits using delay lines as a storage medium, attention was given to three types of magnetic memories. The various components of the input-output circuits were analysed, designed, and tested. Circuit building blocks were designed and subjected to operational tests. A method for packaging the various components was developed. 11 refs.

See also :—
Techniques, Ref. 2180.
Analogue, Ref. 2273.

NUCLEAR

2344 **BAFL-1: a program for the solution of thin elastic plate equations on the Philco-2000 computer.** J. B. Callaghan, P. H. Jarvis and A. K. Rigler, Bettis Atomic Power Lab., *WAPD-TM-255,* April 1961, 34 p., $0.75.

2345 **FORTRAN programs for crystal spacings.** G. M. Wolten, Atomics International, *NAA-SR-6792,* 1 May 1961, 44 p., $0.50.

2346 **FUGUE: a nondimensional method for digital computer calculation of steady state temperature, pressure, and void fraction in pipe flow with or without boiling.** R. C. Noyes, F. Bergonzoli and J. E. Gingrich, Atomics International, *NAA-SR-5958,* 30 May 1961, 37 p., $1.25.

See also :—
Mathematics, Ref. 2166.
Engineering, Mechanical, Ref. 2331.

PHYSICS

2347 **The application of computer techniques to preferred orientation studies.** J. R. Holland, Wright-Patterson AFB, *PB 171870,* Dec. 1960, 19 p., $0.50. A method has been devised and is currently being used to plot normalised pole figures by computer techniques. As the pole distribution traces, i.e., intensity of the diffracted x-ray beam, versus angular position of the specimen are not an acceptable input for the computer, the data required from such traces are entered onto punch cards. Corrections for defocusing effects may be readily made as the data are transferred from the Brown recorder traces to punch cards. It is possible to program other correction factors into the computer operations, providing that these correction factors or curves can be established accurately. The computer translates angular position of the specimen into rectilinear coordinates which are an identical representation of sterographic coordinates. This computer method has been used in conjunction with the Schulz reflection technique, but modification of the program permits its use with other quantitative x-ray techniques for determining preferred orientation. The feasibility of using computer techniques to plot inverse pole figures has been considered. 3 refs.

2348 **Calculation and tabulation of expansion coefficients for N shell molecular two-center integrals by means of the electronic computer BESK.** S. Flodmark, Stockholm University, *AD-257434,* Dec. 1960, 1 v., $5.60. The formulae for all the two-centre integrals occurring in the MO-LCAO method with N shell Slater atomic orbitals is found from the tables of coefficients. The tables were computed by means of Besk according to a flow scheme. Using the corresponding program it is possible to calculate the actual coefficients for integrals containing other shells as well.

2349 **Exercise in alpha programming: table of molecular A and B functions.** S. Flodmark and B. Roos, Stockholm University, *AD-257433,* Nov. 1960, 12 p., $1.60. A program was written using the direct Besk code for the molecular A and B functions. These functions were printed in a duplicated table available at the Institute of Theoretical Physics of the University of Stockholm. The index ranges from 0 to 8 and the A and B functions are printed for arguments alpha and beta between 0 and 50. In the region between 0 and 10 the intervals are 0.01 and in the region between 10 and 50 the intervals are 0.1. In many cases, greater accuracy is necessary than can be obtained from interpolation in the table. Hence it was found very suitable to use the A and B functions as a simple subject for an exercise in alpha programming in connection with the course for this coding system.

2350 **Integral solution of the shallow water sound field.** N. R. Sorensen, Naval Ordnance Lab., *AD-234531 (PB 156641),* 30 Nov. 1959 (Released to public 30 June 1961), 46 p., $4.60. A method is developed for the numerical evaluation of the integral solution to the wave equation for a point source in shallow water over-lying a hard liquid type bottom. This method is useful for intermediate horizontal ranges where satisfactory approximations to the sound field were not found. The integral cannot be evaluated directly because there are singularities in the intergrand. Instead it was transformed into the complex plane in such a way that the resulting integrals and residues can be evaluated on a high speed digital computer. A limited number of calculations were made to illustrate the use of the numerical method. 5 refs.

2351 **A method of design for a prism-erecting telescopic system.** W. J. Growney and W. H. Scidmore, Frankford Arsenal, *AD-256937,* April 1961, 19 p., $2.60. A method of covering the design of an optical system for a prism-erecting telescopic system of 7X, having a field of view of 8 degrees and an exit pupil diameter of 5mm, is presented. Throughout the design, use is made of a Royal McBee LGP-30 computer suitably programmed for computation of the third order aberrations and the tracing of selected trigonometric rays. The design approach starts with an initial set of data, based on past experience, bends the two air spaces of the Erfle eyepiece to effect a desired correction for astigmatism and, finally, bends and corrects the objective lens in order to compensate for the chromatic, spherical, and coma aberrations of the prism eyepiece combination.

2352 **Numerical integration of the Navier-Stokes equation.** J. Gillis, Weizmann Inst. of Science, *AD-252942 (PB 155289),* 15 Jan. 1961, 34 p., $3.60. A description is presented of the relaxation solution for the flow of a viscous liquid in the inlet region of a straight circular pipe at high Reynolds number and analytical work on the application of Laguerre functions to the solution of non-linear differential equations over a semi-infinite range. Preliminary work on flow at low Reynolds number and on the Hammel pattern of flow between non-parallel plane walls is also discussed. 3 refs.

2353 **On the stability analysis of an implicit difference analog of the two-dimensional diffusion equation with concentration dependent diffusivity.** B. Bussell, California University, *AD-256982,* March 1961, 14 p., $1.60. A procedure is demonstrated by which variations in the diffusion coefficient in a two dimensional diffusion equation can be introduced into the solution at every time step in the alternating direction method of solution. This can be accomplished provided that the change in the dimensionless parameter (analogous to the inverse of the Fourier modulus in heat transfer) falls within specified ranges, or an adjustment in the time step can be made to compensate for a portion of the change in the diffusion coefficient so that the allowable bounds on the change are not violated. The conditions as developed for this problem using the von Neumann criterion are sufficient to ensure stability of the difference analogue.

2354 **Transient thermal behavior of decomposing materials. Part I. General theory and application to convective heating.** T. R. Munson and R. J. Spindler, AVCO Corp., *AD-256909*, 3 May 1961, 25 p., $2.60. A mathematical model is presented for the transient behaviour of materials which undergo thermal decomposition. The general model accounts for a rate-controlled decomposition as well as internal heat transfer by conduction, convection, and radiation. The behaviour of the model under conditions of convective heating is examined by means of analogue simulation. Results of this simulation for a charring material and for Teflon are presented and the results on Teflon compared with experimental data. 12 refs.

See also :—
Mathematics, Ref. 2171.
Miscellaneous, Ref. 2360.

SIMULATION

2355 **Simulation Council Newsletter.** J. McLeod (Ed.), *Instr. & Control Systems,* **34,** Aug. 1961, 1475, 1477, 1479-1486. The main items are as follows :

a. **Calculation of microwave antenna radiation patterns by the Fourier integral method.** W. K. Rivers, p. 1475, 1477. Brief account of the use of the Model CF 1 Fourier Integral Computer.

b. **The interconnection of remotely located analog computing equipment.** W. C. Bennett, p. 1477. Discussion of the problem of full flight simulation of an aircraft using two analogue computers located approximately one third of a mile apart.

c. **An automatic blood flow resetting integrator.** A. Spear, p. 1477. Brief account of a resetting integrator for transforming blood flow into the volume of blood delivered per stroke.

d. **Iterative differential analyzer function and control.** M. Gilliland, p. 1477, 1479. Discussion of the advantages of the iterative differential analyser.

e. **Two-level correlation on an analog computer.** C. L. Becker and J. V. Wait, p. 1479.

f. **The role of analog computers in engineering.** Discussion by several participants, p. 1479-1480.

g. **Information on the Analog Computation Lab of the University of Arizona.** G. Korn, p. 1480-1481.

h. **Continuous data analysis with analog computers using statistical and regression techniques.** A. I. Rubin, p. 1481.

i. **Improved transport delay circuits for analog computer use.** W. J. King and V. C. Rideout, p. 1481-1482.

j. **Analog techniques.** R. Howe, p. 1482-1484. Diagrams and brief descriptions of some 16 analogue circuits employing silicon junction diodes.

(Items *a* to *c* are summaries of talks given at the Southeastern Simulation Council meeting of 27 January 1961; items *d* to *g* are summaries or extracts of talks and a discussion at the Rocky Mountain and Western Simulation Councils Joint Meeting of 10 March 1961; and items *h* to *j* are summaries or extracts of talks at the Midwestern Simulation Council meeting of 13 March 1961.)

See also :—
Control—General Systems, Ref. 2305.

TRANSPORT

2356 **International inquiry answering service.** *Data Processing (London),* **3,** July-Sept. 1961, 146-157. A general account of the centralised seat reservation system employed by Scandinavian Airlines System. The system employs a computer specially designed by Informatikwerk, a division of Standard Elektrik Lorenz A.-G. The computer is located in Copenhagen and enquiries from various European cities can be answered; the system will eventually be extended to include New York. Use is also made of an IBM RAMAC computer to compile and keep account of seat reservation totals.

2357 **SABER: a real time problem in tele-processing.** K. S. Hope, *Computer J.,* **4,** July 1961, 109-111, disc. 111-113. SABER was the research code name of a seat reservation system now known as the IBM 9090 Airlines Reservation System which can make use of any of the IBM 7000 series of computers. The paper gives a brief general account of the system.

MISCELLANEOUS

2358 **A computational approach to the four-color problem.** H. Yamabe and D. Pope, *Maths. of Computation,* **15,** July 1961, 250-253. The problem of colouring a map on a sphere with four colours is equivalent to the solution of a certain set of congruences, called here the assignment problem. The assignment problem is shown to be amenable to a simple computational searching routine, which can be easily coded for a binary computer. Coding for the UNIVAC Scientific 1103 is briefly described with two examples. 4 refs.

2359 **Some applications of high-speed computers to the case $n=2$ of algebraic cryptography.** J. Levine, *Maths. of Computation,* **15,** July 1961, 254-260. The use has been proposed of simultaneous linear congruences as a method of encipherment. If the number, n, of such congruences be 5 or more this results in a cryptographic system of unusual security. In this paper it is shown that computers can be used in the problem of decipherment of the simplest case $n=2$. 3 refs.

2360 **Experimental research work on information structures.** E. W. Bastin, Cambridge Language Research Unit, *AD-257974,* 6 March 1961, 17 p., $1.60. The PACE (Brussels, Belgium) analogue computer equipment is being used to investigate a physical interpretation of a calculus (namely the calculus defined by the program of instructions for the computer). The calculus is not completely uninterpreted, but is less interpreted initially than that currently used in physics. In the case under review the calculus is the set of instructions for the PACE equipment set up according to certain rules together with everything the machine turns out, and the intrepretative freedom of the model is being used to attack problems that arise at both large and small ends of our measurement scale, and especially in the fundamental questions underlying the physics of elementary particles, where it is acknowledged that classical concepts of space and time break down.

2361 **The exploitation of personnel data by means of a multiple linear regression model.** R. A. Bottenberg, Lackland Air Force Base, *AD-257499,* 10 p., $1.60. An iterative program for determining weights in a multiple regression problem is described. Large scale regression problems can be economically computed while avoiding the problem of singularity altogether. Use of this program not only provides an effective way of obtaining weights to be used in a prediction equation, but also provides the basis for testing hypotheses. The characteristic of the program make it practical for the researcher to express his hunches in relatively complete detail in formulating a regression model.

2362 **The photogrammetric cloud measurement program.** D. R. Schurz and J. G. Houle, M.I.T., *AD-257774,* Dec. 1960, 47 p., $5.60. This program is conducted to determine the coordinates of a point in space using coordinates taken from a photograph and measured camera calibrations. The program consists of two parts: (1) The data adjustment program (DAP), which linearly adjusts data taken from the photographs; and (2) The general intersection program (GIP), which takes the output of DAP and with measured camera calibration determines the coordinates in space in a normalised system of axes. No practical range restrictions are made. The input data are treated as integers. Therefore, the output has the same scaling and significant figures as the input. DAP uses standard linear adjustment methods. GIP uses rotation and translation matrices based on photogrammetric work. DAP uses approximately 700 locations; GIP uses approximately 1400 locations. DAP will run about 90 points per minute. GIP requires 4 seconds for computing the necessary matrices and operates on the data at the rate of about 50 points per minute.

2363 **Wind speeds from GMD-1 ascents computed electronically compared to plotting board results.** H. A. Salmela, Air Force Cambridge Research Labs., *AD-250861 (PB 154889),* Oct. 1960, 10 p., $1.10. For 30 upper-wind soundings at Montgomery, Alabama, most of the wind speeds evaluated by plotting board in the field for each minute of ascent up to 7 km, and each even minute above that level up to 16 km, differ only slightly from the corresponding speeds evaluated for each identical interval by an electronic computer. The differences increase with height, but even at 50,000ft the median absolute difference is only 1.6m/sec. Some individual differences are large enough to raise questions about the accuracy of winds computed by present methods for the upper portions of some flights. 5 refs.

See also :—
General, Ref. 2112.
Simulation, Ref. 2355*f*.

2364 **Bibliography of Mechanical Translation.** E. and K. Delavenay, Mouton & Co., 1960, 69 pages, £1. 0. 0. This book, in English and French, contains some 300 or more subject-classified, briefly-annotated references on mechanical translation. There is a brief introduction and also an author index.

2365 **Cybernetics.** N. Wiener, John Wiley & Sons, 1961, Second Edition, 225 pages, £2. 8. 0. The contents of this new edition, which has been thoroughly rewritten, are: Newtonian time and Bergsonian time; Groups and statistical mechanics; Time series, information and communication; Feed-back and oscillation; Computing machines and the nervous system; Gestalt and Universals; Cybernetics and psychopathology; Information, language and society; On learning and self-reproducing machines; Brain waves and self-organizing systems.

2366 **Iterative arrays of logical circuits.** F. C. Hennie, John Wiley & Sons, 1961, 256 pages, £1. 18. 0. An M.I.T. Press Research Monograph which explores the techniques used for analysing the behaviour of one- and two-dimensional iterative networks formed of discrete, or logical, elements. It presents a logical development of the properties of the various classes of iterative systems and the tests that are available for answering simple questions about them and techniques that are presently used for designing and simplifying sequential switching circuits. Contents: Introduction; Decidable Systems; Undecidable systems; Analysis of transient behaviour; Relative capabilities of iterative systems; The analysis of iterative systems; Synthesis of unilateral systems; Additional topics in the design of unilateral systems; Synthesis of more general iterative systems; Reduction techniques; Conclusions.

AUTHOR INDEX

Almond, G. 2297
Amble, O. 2176
Andersen, C. 2156
Anderson, B. L. 2194
Anderson, R. A. 2198
Anderson, S. F. 2232
Antipov, I. 2224
Arden, B. W. 2278 2281
Argyris, J. H. 2288
Arkéus, S. 2314
Auer, G. G. 2318

Bagshaw, A. R. 2108
Balasinski, W. 2276
Baldwin, C. J. 2324
Barber, D. L. A. 2227
Bardell, P. H. 2241
Baskin, H. 2137
Bastin, E. W. 2360
Battey, P. 2215
Becker, C. L. 2355*e*
Bedrij, O. J. 2222
Bellmer, W. A. 2214
Bender, R. R. 2206
Bennett, W. C. 2355*b*
Bergonzoli, F. 2346
Blaauw, G. A. 2125 2277
..... 2284 2286
Blachman, N. M. 2105
Blauvelt, D. H. 2210
Block, H. D. 2149*b* 2149*c*
Bottenberg, R. A. 2361
Bourne, C. P. 2150
Braen, H. P. 2211
Brain, A. E. 2142 2150
Bramhall, J. N. 2186
Briggs, F. E. A. 2297
Brooker, R. A. 2280
Brouwer, D. P. 2307
Brown, B. M. 2309
Brown, D. T. 2198
Brown, H. E. 2317
Brucker, G. 2308
Brule, J. D. 2175
Bubenko, J. A. 2314
Buchanan, L. W. 2313
Buehler, R. 2165
Bullingham, J. M. 2140
Burk, H. H. 2211
Busby, E. L. 2328
Bussell, B. 2353
Buzzell, G. 2119

Caffrey, J. 2177*f* 2177*g*
Callaghan, J. B. 2344
Campbell, E. S. 2165
Carter, G. K. 2327
Chirlian, P. M. 2229
Chow, T.-S. 2167
Clapper, G. L. 2238
Clarkson, W. K. 2181
Clavier, P. A. 2145
Clowes, M. B. 2143
Colandene, B. T. 2202
Coleman, P. D. 2146
Coleman, R. L. 2163
Comét, S. 2184
Connelly, M. E. ... 2289 2293
Couch, R. W. 2233
Craft, J. L. 2337
Cronquist, D. H. 2209

Dandeno, P. L. 2325
Davis, P. C. 2132
Daykin, P. R. 2234
Dekkers, A. J. 2159
Delavenay, E. 2364
Delavenay, K. 2364
Delves, L. M. 2166
DeSalvo, C. A. 2324
Desoer, C. A. 2310
Dieffenderfer, J. 2226
Dinneen, G. P. 2112
Douglas, A. S. 2204
Duijvestijn, A. J. W. ... 2159
Dunning, R. S. 2290
Duren, K. D. Van 2172
Dyrkacz, M. S. 2322

Earls, J. C. 2178
Edwards, H. H. 2240
Eggleston, J. M. 2290
Ender, R. C. 2318
Eppink, R. T. 2332

Faulkner, C. E. 2212
Filler, L. 2171
Fischer, L. G. 2273
Fischler, M. A. 2131
Fletcher, E. W. 2129
Flodmark, S. 2348 2349
Francis, J. G. F. 2191
Frenkel, G. 2273
Frick, F. C. 2112
Fuller, H. W. 2247

Gagan, R. P. 2148
Galage, D. J. 2206
Galler, B. A. 2278 2281
Gärtner, W. W. 2306
Garwick, J. V. 2176 2283
Gauss, E. J. 2187
Gautschi, W. 2168
Geisler, M. A. 2305
Gevas, P. 2294
Giaimo, E. C. 2248
Gibb, A. 2177*a*
Gill, D. W. 2201
Gilliland, M. 2355*d*
Gillis, J. 2352
Gingrich, J. E. 2346
Ginsburg, S. 2141
Glinski, G. S. 2239
Goldman, E. H. 2337
Goldsteen, R. 2213
Goldstick, G. H. 2115
Graham, R. M. ... 2278 2281
Green, B. F. 2336
Grems, M. 2106
Grim, R. K. 2307
Grimsdale, R. L. 2140
Growney, W. J. 2351
Gruodis, A. J. 2241
Guignabodet, J. J. 2117

Harmon, L. D. 2142
Harmon, W. L. 2294
Harper, K. E. 2339
Hartman, A. E. 2316
Hatcher, T. L. 2328
Hays, D. G. 2342
Hedrick, G. B. 2284
Heilweil, M. F. 2225
Heller, J. 2285
Hemphill, A. P. 2194
Hennie, F. C. 2366
Herndon, J. R. 2177*b*
Hershberg, P. I. 2291
Herzenstein, Z. 2297
Hills, F. B. 2196
Hindle, R. 2295
Hirschfelder, J. O. 2165
Hoare, C. A. R. ...2177*c* to *e*
Holland, J. H. 2154
Holland, J. R. 2347
Holmstrom, J. E. 2109
Hook, H. O. 2248
Hope, K. S. 2357
Houghton, A. V. 2192
Houle, J. G. 2362
Howe, R. 2355*j*
Hughes, D. 2165

Izumi, H. 2236
Jarvis, P. H. 2344
Jennings, G. 2298
Johansen, D. E. 2189
Johnson, C. H. 2292*a*
Johnston, R. C. 2244
Jones, F. B. 2282

Kanal, L. 2144
Katz, J. R. 2292*c*
Kellogg, D. A. 2338
Kelsey, S. 2288
Kel'zon, A. S. 2111
Kesavan, H. K. ... 2321 2326
Kesler, C. 2149*d*
Kilmer, W. 2130
King, W. J. 2355*i*
Kirchmayer, L. K. 2317
Klahr, D. 2148
Klopfenstein, R. W. 2173
Knight, B. W. 2149*c*
Kochen, M. 2183
Koenig, H. E. 2321 2326
Korn, G. 2355*g*
Kostyshyn, B. 2203
Kozarsky, K. 2287
Kozharskiy, L. A. 2127
Krarup, T. 2185
Kravitz, S. 2161
Ku, T. C. 2197

Landauer, R. 2107
Landolt, J. P. 2239
Larson, R. H. 2118
Lazarkiewicz, A. 2276
Lee, C. Y. 2138
Leibowitz, M. A. 2157
Levine, J. 2359
Limmer, H. D. 2324
Lindemann, P. 2300
Loeb, A. L. 2129
Lombardi, L. 2193
Long, P. A. 2200
Luchter, S. 2331
Ludloff, H. F. 2171
Luke, Y. L. 2163

MacDonald, E. H. 2327
McIntyre, G. W. 2315
Mackie, D. G. 2115
McLeod, J. 2355
Maginniss, F. J. 2322
Mann, W. C. 2124
Marcus, M. P. 2188
Maron, M. E. 2333
Marsocci, V. A. 2229